PUBLISHED EVERY SATURDAY BY
THE W. J. JOHNSTON COMPANY, Limited.
167-176 TIMES BUILDING, NEW YORK.
Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 28 Hathaway Building, Boston.
Western Office, 465 The Rookery, Chicago.
Philadelphia Office, 927 Chestnut Street.

SUBSCRIPTION IN ADVANCE, ONE YEAR $3.
(Including Postage in the U. S., Canada or Mexico.)

Address all communications to
THE W. J. JOHNSTON COMPANY, Ltd.,
Times Building, New York,
OR ANY OF THE BRANCH OFFICES.

VOL. XXI. NEW YORK, JAN. 7, 1893. NO. 1.

CONTENTS.

EDITORIAL: PAGE
Paragraphs ... 1
ILLUSTRATED ARTICLES:
Electrical Progress During 1892 ... 3
The Cologne Municipal Lighting Station—I.: C. P. Feldman ... 5
Electricity at the World's Fair ... 9
Experimental Researches in Alternate Current Transformers—II., by Dr. J. A. Fleming ... 15
The Harris Patent Anti Friction Trolley Base ... 16
Pfluger's Wire Tightener ... 16
Large Power Press for Cutting Out Armature Discs ... 16
MISCELLANEOUS:
The Incandescent Lamp Situation ... 2
The Street Railway Supply Men's Association ... 2
The Alternate Current Ampère ... 2
Short *vs.* Long Armatures, by T. H. Reardon ... 2
On Inert Gases in Incandescent Lamps, by Dr. L. K. Böhm ... 4
Progress of the Chicago & St. Louis Electric Railway ... 4
High *vs.* Low Frequency in Transformers, by Louis T. Robinson ... 7
Regulation Test of the Ryan Special Series Motor, by W. L. Bliss ... 7
History of Electricity, by P. F. Mottelay ... 8
The Large Search Light for the World's Fair ... 9
Experimental Determination of Electrical Oscillations ... 9
Electrical Progress in Germany ... 12
Practical Primary Batteries ... 12
Aluminium ... 12
Effect of Electric Light on Plants ... 12
Report of the Board of Trade Committee on Electrical Standards ... 13
An Ideal Central Power Station, II., by C. J. Field ... 14
Chicago Going into the Electric Lighting Business ... 15
FINANCIAL INTELLIGENCE: The Electrical Stock Market, 17; New Incorporations, 17; Affairs of the Companies, 17.
SPECIAL CORRESPONDENCE: New York Notes, 18; New England Notes, 18; Philadelphia Notes, 18; Pittsburgh Notes, 18; Western Notes, 18.
NEWS OF THE WEEK: The Telephone, 19; The Electric Light, 19; The Electric Railway, 19; Personals, 19; Miscellaneous Notes, 19; Legal Notes, 19.
INDUSTRIAL AND TRADE NOTES ... 20
BUSINESS NOTICES ... 20
OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS ... 20

Publications of the W. J. Johnston Co., Ltd.

THE ELECTRICAL WORLD. An Illustrated Weekly Review of Current Progress in Electricity and Its Practical Applications. Subscription, in advance, one year ... $3.00

JOHNSTON'S ELECTRICAL AND STREET RAILWAY DIRECTORY, Containing Lists of Central Electric Light Stations, Isolated Plants, Electric Mining Plants, Street Railway Companies—Electric, Horse and Cable—with detailed information regarding each; also Lists of Electrical and Street Railway Manufacturers and Supply Dealers, Electricians, etc. Published annually ... 5.00

THE TELEGRAPH IN AMERICA. By JAS. D. REID. 894 royal octavo pages, handsomely illustrated, Russia ... 7.00

DICTIONARY OF ELECTRICAL WORDS, TERMS AND PHRASES. By EDWIN J. HOUSTON, A. M. Second edition, entirely rewritten. 5,000 definitions, 562 double column octavo pages, 570 illustrations ... 5.00

THE ELECTRIC MOTOR AND ITS APPLICATIONS. By T. C. MARTIN and JOS. WETZLER. With an appendix on the Development of the Electric Motor since 1888. By Dr. LOUIS BELL. 315 pages, 353 illustrations. 3.00

THE ELECTRIC RAILWAY IN THEORY AND PRACTICE. The First Systematic Treatise on the Electric Railway. By O. T. CROSBY and Dr. LOUIS BELL. Octavo, 400 pages, 179 illustrations ... 2.50

ALTERNATING CURRENTS. Treated Analytically and also Treated Graphically. By FREDERICK BEDELL, Ph. D., and ALBERT C. CREHORE, Ph.D. Uniform in size and style with Crosby & Bell's "Electric Railway" ... 2.50

PRINCIPLES OF DYNAMO-ELECTRIC MACHINES and Practical Directions for Designing and Constructing Dynamos. By CARL HERING. Sixth thousand, 279 pages, 59 illustrations ... 2.50

ELECTRIC LIGHTING SPECIFICATIONS for the Use of Engineers and Architects. By E. A. MERRILL. 175 pp. 1.50

THE QUADRUPLEX. By WM. MAVER, JR., and MINOR M. DAVIS. With Chapters on Dynamo-Electric Machines in Relation to the Quadruplex, Telegraph Repeaters, the Wheatstone Automatic Telegraph, etc. 126 pp., 63 illustrations ... 1.50

THE ELEMENTS OF STATIC ELECTRICITY, with Full Description of the Holtz and Töpler Machines. By PHILIP ATKINSON, Ph.D. 328 pages, 64 illustrations ... 1.50

LIGHTNING FLASHES. A Volume of Short, Bright and Crisp Electrical Stories and Sketches. 100 pages, copiously illustrated ... 1.50

ELECTRICITY AND MAGNETISM. A Series of Advanced Primers. By EDWIN J. HOUSTON, A. M. ... 1.00

RECENT PROGRESS IN ELECTRIC RAILWAYS. Being a Summary of Current Advance in Electric Railway Construction, Operation, Systems, Machinery, Appliances, etc. Compiled by CARL HERING. 386 pages, 120 illus. ... 1.00

ORIGINAL PAPERS ON DYNAMO MACHINERY AND ALLIED SUBJECTS. Authorized American Edition. By JOHN HOPKINSON, F. R. S. ... 1.00

DAVIS' STANDARD TABLES FOR ELECTRIC WIREMEN. With Underwriters' Rules, Instructions for Wiremen and Linemen, Plates of Circuits and Useful Data. Third Edition. Revised by W. D. WEAVER ... 1.00

UNIVERSAL WIRING COMPUTER for Determining the Sizes of Wires for Incandescent Electric Lamp Leads and for Distribution in General Without Calculation, with Some Notes on Wiring and a Set of Auxiliary Tables. By CARL HERING. 44 pages ... 1.00

EXPERIMENTS WITH ALTERNATING CURRENTS OF HIGH POTENTIAL AND HIGH FREQUENCY. By NIKOLA TESLA. 146 pages, 30 illus. 1.00

LECTURES ON THE ELECTROMAGNET. Authorized American Edition. By Prof. SILVANUS P. THOMPSON. 287 pages. 75 illustrations ... 1.00

WHEELER'S CHART OF WIRE GAUGES ... 1.00

PRACTICAL INFORMATION FOR TELEPHONISTS. By T. D. LOCKWOOD. 192 pp. ... 1.00

A Remarkable Record. WITH the beginning of the present year THE ELECTRICAL WORLD extends the season's greetings to all of its readers, together with congratulations for the remarkable advances of the year 1892 in nearly all branches of the electrical industry. A brief review of these advances, in which many of our readers have taken a prominent part, is given in another column. No one can look over the record of the year as contained in nearly 1,000 pages of THE ELECTRICAL WORLD without noting the fact that it has been pre-eminently a year of bold projects and magnificent undertakings in all lines of electrical engineering. THE ELECTRICAL WORLD looks back over its score of volumes proud of the record which, with the assistance of its numerous friends, it has been able to make in the past decade. Our readers may rest assured that it will be our aim in succeeding years to present an even better record of electrical progress.

Jumping at Conclusions. IT seems to be the rule now that if the cause of a fire is unknown it is immediately attributed to electricity. The best and only reason we can find for this, and doubtless a very satisfactory one to the mind of the average newspaper reporter, is the following argument copied after those used in elementary treatises on mathematics: (a) Electricity is something the exact nature of which is unknown; (b) the origin of that fire is something the exact nature of which is unknown; (c) therefore, as things equal to the same thing are equal to each other, the origin of that fire is electricity.

Trolley vs. Telephone Lines. IF the bare telephone and telegraph lines are going to make the trolley wire a source of danger in starting fires, then so much the worse for the bare telephone and telegraph wires. They *can* be put underground, the overhead trolley wire cannot. They *can* be insulated, the trolley wire cannot. The unsatisfactory telegraph and telephone service would furthermore be greatly improved if their wires were properly laid underground, where they belong. The very high price paid for such poor service certainly justifies the demands that these wires be buried, particularly now as the trolley is coming.

Trolley Wires Under the Elevated Structure. THE objections made to stringing trolley wire under the elevated railway structure are absurd and unreasonable. As a fire starter a trolley wire placed there is as free from danger as if it were underground, and is much safer than an aerial telephone or district call wire strung over the tops of high buildings with one end grounded, therefore making an excellent lightning rod to lead the lightning into thousands of offices and houses. It would be well for those concerned in awarding and rejecting proposals for the trolley to consult electrical engineers, who could give them a pointer or two about the relative danger of overhead wires.

Cost of Electric Traction. THE daily papers, in their onslaught on the trolley roads, inadvertently paid that system of traction a compliment when they denounced it as a "cheap" system. There has been much discussion in the past few years as to whether electric traction could be operated at less cost than with horses, but the fact that the former is now universally recognized as a cheaper system ought to satisfy those who contemplate introducing the electric system and who are still in doubt as to the relative profits in the investment in the two systems. The general public, who are interested only in the kind of service, ought to appreciate the fact that if the owners of a road are able to operate it at a less cost they are more apt to give the public better service, either by increasing the speed, the number of cars or the seating capacity of the cars.

The Trolley and Insurance Rates. IT seems hardly reasonable that the introduction of the trolley road in an outlying, sparsely settled part of this city should be the cause of a raising of the insurance rates over the whole city of New York, though the announcement that such a raise has been determined upon by the Board of Fire Underwriters followed almost immediately the report that the trolley franchise had been granted. The fire insurance premiums paid in this city amount to over $7,000,000 annually, even only a slight raise of which is no small burden on an already overtaxed community. But as a rise in insurance rates has followed the trolley in Boston, Brooklyn and New York, even though seemingly unjust, companies introducing electric railways will find it greatly to their interest to give their very best attention to making the trolley wire absolutely safe, even at considerable expense, against being crossed.

A Competitor of the Arc Light. A MAGNESIUM light, for which such a great future was promised some 20 years ago, has been revived again, and in its present improved form it may, perhaps, become a successful competitor of the arc light, at least in a limited field. The improvements in the present form consist in blowing air, by means of bellows, first through a volatile petroleum compound, such as naphtha or benzol, which carburets it, then through a mass of very finely divided magnesium powder, and then near a constantly burning flame which ignites the gas and the powdered magnesium which it contains. For flash lights these puffs of air are intermittent, and are regulated by a clockwork. In a lamp of this sort tried recently at the Government Lighthouse Station, on Staten Island, the bellows were driven electrically. The candle power is given as 400,000, but as it was not stated whether this means an average spherical illumination, as with ordinary lights, or an illumination in a plane, as with lighthouse lights, or a parallel beam as from a projector, no comparison can be made from it with the arc light. Probably, however, a beam in the form of a nearly horizontal plane is meant, but even then this figure carries little meaning with it unless properly qualified, for if it was measured with the ordinary photometer and calculated from the law of the inverse squares of the distance, it is not correct, as such a beam does not follow this law. This light was said to be visible as far as the curvature of the earth permitted. The principal objection to the electric light for lighthouse purposes is that its light does not pass through a foggy atmosphere as well as that from oil lamps. Whether this magnesium light is superior to it in this respect remains to be seen; if so, and if there are no new objections introduced, it will doubtless supersede the electric light for lighthouse purposes. It is a question, however, whether the fumes formed will not deposit on the lenses and reflectors, which, of course, would be a fatal fault. It is not likely that it will be used for search lights owing to the large size of the flame, which prevents it from being projected in anything approximating a parallel beam, and that means a great waste of light. Prof. Nichols, of Cornell University, has tested the properties of this light and states that it gives a larger percentage of light and a smaller percentage of heat than any other combustible known, and it is therefore a step toward the ideal illuminant, the "cold light." Whether the arc light, which was the most economical from this standpoint, is included as a "combustible" is, unfortunately, not stated.

Electric Cranes. IN a recent number of our contemporary *Engineering News* there is an article on "Some Defects of Electric Traveling Cranes," in which a doubt is raised whether the electric crane is really better than its rivals, and whether its rapid introduction is not due to a great extent to its popularity rather than to real superiority. The article refers to the tests recently made at the Watervliet Arsenal, which we criticised unfavorably in these columns some weeks ago, and which gives the efficiency as 20 to 60 per cent. We pointed out that the mean efficiency given was very likely too low, and that the deductions were in part incorrect and misleading. Our contemporary argues that an electric crane is wasteful on account of its lack of storage of the power required and compares it with the hydraulic crane, which possesses this property. Figures would doubtless show that the alleged economy in being able to store power is a delusion, as the all-day efficiency of electric transmission even, if intermittent in character, is probably much greater than that of any storage system, be it electric, hydraulic or pneumatic. The article furthermore credits the first cost of the electric system with that of a separate steam engine having the maximum capacity of the crane, and concludes that therefore the old style square shaft and the rope system would probably be cheaper. This is decidedly unjust, as there is no more reason why the dynamo should require a special engine any more than the square shaft or the rope system. A dynamo can be driven from the main shafting just as well as a rope or a shaft. That the first cost of an electric system may be greater we do not deny, but this ought not to be called a "defect" any more than that a suit of clothes made of more serviceable materials could be called more "defective" than cheaper ones simply because it is more expensive. As regards the total "all-day" efficiency, that is, taking into account that during a great part of the day a crane is idle, but must be ready, there is little doubt that the power required to keep the dynamo up to speed for use is very much smaller than that required to keep a long, square shaft or a rope in continuous motion. We even go futher and state that the efficiency at full load will doubtless be in favor of the electric system. But there are other questions which enter. A broken rope of such a length makes sad havoc among the fine machine tools beneath it, and that system must be credited with this defect. The efficiency of rope transmission is known to be very poor; in Switzerland where this system was formerly used largely it is now being replaced rapidly by electric transmission. But perhaps the best argument is that the "proof of the pudding is the eating;" the fact that the electric crane has met with such favor and is now rapidly replacing the older methods certainly is the best kind of proof of its superiority, as those who adopt it may certainly be credited with having looked into the question of the relative first cost and efficiency of the various systems before they decide which one to adopt. The rapid introduction in workshops and factories of separate electric motors for each machine in place of the former system of countershafting shows in general the superiority of electric over belt transmission.

The Incandescent Lamp Situation.

Just how the incandescent lamp industry will eventually be solved is the question of the day in the electrical field. The present uncertainty is seriously affecting the electric light interests. Contractors are unable to make reliable estimates in the present condition of the market, and the consumers hesitate to install new plants or enlarge old ones without knowing whether or not it will be possible to obtain incandescent lamps at all, or at what price. It is probable, however, that the present state of affairs will not long continue, and that in the near future some solution of the question will be reached.

There seems to be considerable difference of opinion as to what the outcome of the situation will be and who will really secure the benefits of the recent decisions. On the one hand it is claimed that the General Electric Company is in sole possession of this profitable field, and can drive all its competitors out at will, and enjoy the privilege of manufacture of all incandescent lamps in this country. Others express the opinion that the recent decisions have only embarrassed the General Electric Company, and can result in no real benefit to it; that the local companies or licensees of the Edison Electric Light Company are the parties who will secure whatever advantages there may be, and who have it in their power to dictate terms to the General Electric Company, and practically control the incandescent lamp market.

It is generally admitted that should the new Westinghouse lamp be a practical success the present condition of affairs would be relieved and the situation would be much as it was before the decision in favor of the Edison patents. There is, however, a wide difference of opinion as to the practicability of the lamp which the Westinghouse people have promised soon to place upon the market, and whether or not it will prove an infringement of the Edison patents.

As to the exact time at which the new lamp will make its appearance the Westinghouse company make no more definite statement than to say that shipment of their new lamps will begin early this month. The problem of manufacturing a sufficient number of lamps to supply the entire demand is difficult to meet promptly, and the Westinghouse company is prepared to turn out from 15,000 to 20,000 lamps daily and in addition to this to renew the carbon in all lamps that may be returned during the month of January. The company expects to be able to take care of all its customers who must have new lamps, and soon after to fill all orders which may be received. As the business develops it is stated that "renewal stations" will be erected in all large cities, such as New York, Boston, Philadelphia, Chicago, etc., in order to reduce cost of shipment and return of lamps for renewal, and thus reduce the net cost of lamps to the consumer.

In a recent announcement of the Westinghouse company some information in regard to the new lamp is given, which may prove of interest at this time. The lamps are to be made in separable parts, so that the carbon burners may be replaced and the glass parts used repeatedly. The bases being molded of uniform size to fit a specially designed socket, the lamps are said to be neater in appearance than the all-glass globe form. The carbon burner will be preserved by an atmosphere of nitrogen, and their candle power, it is claimed, maintained more nearly constant than heretofore, by means of a recent important discovery.

Special sockets of neat design will be employed for these lamps, and special fittings will be supplied at five cents each and will adapt any of the former sockets to receive the new lamps, thereby bringing about exact uniformity in lamp bases. In reference to the cost and efficiency of the lamps the Westinghouse company makes the following statement in its announcement:

"By reason of manufacture of the lamps by special machinery and improved methods, by the use of nitrogen for preserving the carbons, and by means of pumping and charging apparatus recently perfected, we have been able to so reduce the cost of manufacture as to fix our prices for 8, 10 and 16 c. p. lamps at 30 cents each, subject to a discount of 10 per cent. to our central station customers, and to others from 2½ per cent. upward, according to quantity, with an allowance of 10 cents for every burned-out lamp returned unbroken to any one of our factories, making the net cost of renewals for the 8, 10 and 16 c. p. lamps 17 cents to our central station customers. For 20 and 25 c. p. lamps the prices will be 35 cents each, subject to the same discount and allowance for burned-out lamps.

"By long and careful tests, and by the use of a large number of these lamps in our works, we have demonstrated that the new lamp will have greater advantages for users than the Edison lamp or any of those heretofore upon the market.

"The importance of the improvements in manufacture by which we have been enabled to offer these lamps at so low a price will be appreciated by all users who are aware of the constant deterioration in the carbon burners, and of the fact that the real commercial efficiency of a lamp is its average efficiency. With a constant amount of electric current the ordinary 16 c. p. lamps rapidly fall below 10 c. p. from the deterioration of the carbon, when they must be renewed; and it results from this that the users, with cheaper lamps, will get from 15 to 20 per cent. more light from a given expenditure of electricity by a more frequent renewal of lamps than is now customary. Thus the low cost of the lamps may be made to add to the revenue of a lightin station in one of two ways, viz., either by giving a greater lighting capacity at the present cost of lamp renewals, or by actual saving in the cost of lamps with renewals made at the present period of renewal."

A prominent representative of the General Electric Company states that the difficulties are rapidly being adjusted in a manner entirely satisfactory to that company, and that within the next 30 days important developments will probably be made. While it is within the power of the local companies to cause considerable trouble, they have thus far given every indication of a desire to settle the matter as amicably and speedily as possible, and no serious difficulty is anticipated in this direction. It is impossible to outline the policy of the General Electric Company, as there are at present so many uncertain factors in the case and no one can tell exactly what course will be pursued.

A gentleman well qualified to speak on this subject takes the following view of the situation:

"All the benefits of the recent decisions in the Edison lamp patent suit accrue to the licensees of the Edison Electric Light Company; they are in command of the situation and have the power to dictate terms, to a greater or lesser extent, to the General Electric Company. In the early days of electric lighting the Edison Electric Light Company made arrangements with local companies in Boston, New York, Philadelphia, Chicago, New Orleans, Brooklyn, Detroit, and almost all of the important cities in the country, by which these local companies had the exclusive and absolute right to the sale of Edison apparatus in their respective territories. In return for this they gave to the Edison company a certain percentage of their capital stock, not for one year or two years, or any fixed length of time, but perpetually and upon any increase of capital stock. These licensees, however, were not guaranteed by the parent company against infringers of the Edison patents, or given protection in any way equal at the time to the rights which they sacrificed. The makers of other apparatus which infringed the Edison patent come into their territory unmolested and sold in competition with them. The result was that during the past 10 years the licensees have not secured any considerable portion of the profits which justly belong to them.

"In return for the stock which they surrendered the local companies were to secure a special rate upon lamps and other apparatus, which would enable them to compete successfully with any rivals. As a matter of fact this privilege was never secured and the apparatus of other manufacturers could be obtained upon the market at a price which was actually less than that which they had to pay to the parent company.

"In consequence of all this some of the licensees are not at present in a very friendly attitude toward the General Electric Company, which represents not only their parent company, but also their most active competitors, and are prepared to take advantage of the situation to recover in some way the benefits which they have not secured in all these years. They are now in a position to say to the General Electric Company, 'We will not allow you to sell lamps to any parties within our territory; we ourselves will not sell lamps to any company or corporation which has established itself in business since the decision of last July or to any others except at a price which we may fix, and which may be regarded as within the limits set by the recent decree of the court.' This would place the General Electric Company more or less at the mercy of these local companies, since three-fourths of the incandescent lamp business of the country is controlled by them, and the remaining quarter only would not be a profitable field.

"Long before the consolidation of the Thomson-Houston company and Edison company the former sold its apparatus within the territories of the Edison licensees with the guarantee that purchasers should be protected against all infringement of the Edison patents. If now the licensees of the Edison Electric Light Company refuse to sell lamps to purchasers of Thomson-Houston, Brush, Fort Wayne, Jenney or other apparatus which was made or controlled by the Thomson-Houston company, those purchasers will immediately demand of the Thomson-Houston company, that is the General Electric Company, the protection which their contracts demand. It is thus seen that the General Electric Company is placed in a very awkward situation.

"The General Electric Company cannot sell the right of manufacture of incandescent lamps to outside parties, for if this were done the local companies would immediately refuse to permit such lamps to be sold within their territory, and no manufacturer would care to supply the small portion of the field which was left free. Even if such a manufacturer could be found, it would be impossible to keep his lamps out of the territory covered by the contracts with the licensees, and as soon as such lamps were found in those territories and traced back to the manufacturer the licensees would be entitled to, and would undoubtedly be able to obtain, heavy

"The situation is thus very complicated, and it is questionable whether the decision in favor of the Edison patents is not really an elephant on the hands of the General Electric Company. It is difficult to say in what way the decision can result in any profit to the company, and it certainly is causing it considerable embarrassment.

"In regard to the new lamp which the Westinghouse company has promised to place upon the market Jan. 1, if it should prove a commercial success it would certainly relieve the situation and be welcomed by all consumers. At present, however, it seems doubtful whether such a lamp will be a practical success, and admitting it will be, it is not entirely clear that it can escape infringement of the Edison patents. The statement has been made by the Westinghouse company that the new lamp will be sold at the price of 17 cents. It does not seem possible that a lamp could be manufactured and sold at this price with any profit, but it is quite probable that the Westinghouse company will be willing to sell lamps at cost in order to embarrass the General Electric Company and complicate the situation. Even if such a lamp should prove ultimately to be an infringement of the Edison patents, and it should burn even 200 hours, it would enable the Westinghouse company to carry on the fight and continue the manufacture of lamps until the expiration of those patents."

The Street Railway Supply Men's Association.

The following report has been sent out by John E. Lockwood, chairman of the meeting of supply men, held at Cleveland, during the Street Railway Convention:

As the report of the committee which I, as chairman of the meeting of supply men held at the Cleveland Street Railway Convention, appointed for the purpose of consulting with the Executive Committee of the American Street Railway Association, was not received in time to allow of the calling of a meeting of the supply men before the close of the convention, and realizing that all supply men are interested in this matter and desire a knowledge of this report, I give same herewith, as follows:

CLEVELAND, O., Oct. 20, 1892.

Mr. Jos. E. Lockwood, Chairman:

DEAR SIR—The undersigned committee appointed by you to confer with the Executive Committee of the American Street Railway Association, beg to submit the following report: That a majority of the committee waited upon the Executive Committee of the American Street Railway Association, at their headquarters at the Hollenden hotel, and briefly stated the case, as the time had then arrived for the convening of the association, and wanted to settle the matter definitely for the present. It was moved by Mr. Lang of the Executive Committee, and unanimously carried, that it was the sense of the Executive Committee that the association of supply men, such as was contemplated, *was not necessary at the present time.*

Respectfully submitted,

DANIEL COLLIDGE,
WM. P. CLARK,
JAS. H. MCGRAW,
PAYSON K. ANDREWS,
LOUIS E. MYERS,
Committee.

The Alternating Current Ampere.

Referring to the definition of the alternating current ampère in the report of the committee of the Board of Trade on electrical standards, *Engineering* says:

"The definition of the strength of an alternating current is made to depend on the square root of the time average of the square of its strength at each instant of its period, which is not, it must be confessed, readily intelligible, but it may, perhaps, be put as follows: The ampèrage of an alternating current is equal to that of a constant current, when the heating effects of the two currents passing through equivalent resistances are the same. If the resistance is constant and non-inductive the heating effect measures the whole energy expended and is proportional to the square of the current, and when the latter is constant is very easily calculated. If the current is alternating we may divide its period into a convenient number of small parts and consider the current as having a constant but different value throughout each of these parts. If we add all these strengths together, and divide by the number of parts, we shall get a mean value of the current, which, however, will prove to be zero if taken through a complete period, as for each value of the current in one direction there will be an equal value of current in the opposite direction, and taking note of this difference in sign, the average current will be zero. If, however, we regard the heating effect, we shall obtain this by adding together the squares of all the values of the current throughout its period. Dividing this by the number of values, we shall have the mean value of the square of the current, and the square root of this will be equal to the strength of a constant current having the same heating effect. This process is, in short, that of finding the square root of the time average of the square of its strength at each instant of its period."

Short vs. Long Armatures.

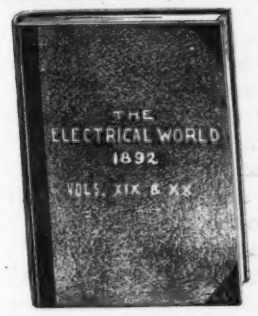
BY T. H. REARDON.

In THE ELECTRICAL WORLD of Dec. 17 Prof. Crocker shows, in a very interesting way, the relative advantage of short and long armatures. That the points taken by Prof. Crocker are beyond dispute all will admit. There are one or two details which he mentions that are not quite clear to me, however. He says, "The number of armature windings would be twice as great in the case of the shorter drum." If the same number of revolutions per minute are preserved in both cases, this is not necessarily true, unless twice the E. M. F. is desired. With the same number of windings in each case and the same number of revolutions, the same E. M. F. will be generated. With only the same number of windings on the short drum the depth of winding need be only one-half of what it is on the long drum, as the periphery has twice the length. It is obvious that each wire on the surface of the drum will cut the entire field of force twice during each revolution; whether the aforesaid wire is six or twelve inches will not make a particle of difference. Windings of only one-half the original depth will make a very important difference in the length of the air gaps, and, consequently, in the M. M. F. required in the field coils.

Electrical Progress During 1892.

AS one looks back over the year 1892 it certainly appears to have been a year of magnificent advances in nearly all branches of the electrical industry. The practical applications of electricity have been multiplied, new apparatus for new purposes placed upon the market, old apparatus improved, and new discoveries and inventions have found wide application in actual service.

During the year the literature of the subject has received many valuable additions in the shape of books on the practical applications of electricity, from writers who are thoroughly qualified for discussing the problems involved. The number of books brought out during the year is probably in excess of any previous twelve month that could be selected. Among the more important ones may be mentioned "The Electric Railway in Theory and Practice," by O. T. Crosby and Dr. Louis Bell; the fourth edition of Prof. S. P. Thompson's standard work on "Dynamo-Electric Machinery"; the second edition of Prof. Houston's "Dictionary of Electrical Words, Terms and Phrases"; the third edition of James Clerk Maxwell's classical work on "Electricity and Magnetism"; Prof. J. A. Ewing's excellent treatise on "Magnetic Induction in Iron and Other Metals"; "American Telegraphy," by William Maver, Jr.; a reprint of the original edition of Carl Hering's "Practical Directions for Winding Magnets"; Dr. John Hopkinson's "Collected Papers on Dynamo Machines," and an excellent handbook on the practical management of dynamos and motors by Prof. F. B. Crocker and Dr. S. S. Wheeler. Besides these, many similar books of practical value have been published, as will be seen by reference to the index to the two volumes of THE ELECTRICAL WORLD covering the year 1892.

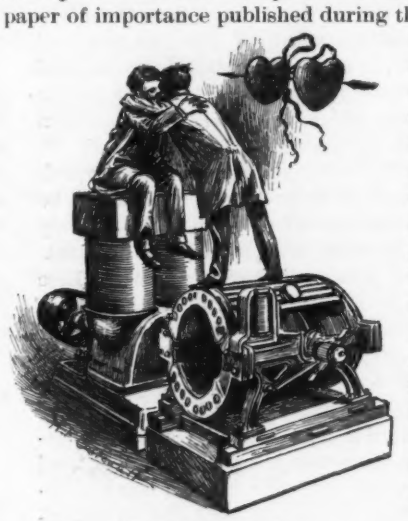


The telegraph exhibits perhaps the least advance of any of the practical applications of electricity. This is due, of course, to the fact that telegraphy, as a science, is well advanced, and because the apparatus used is in general giving satisfaction to the operating companies, so that there is very little, if any, inducement to inventors to make improvements along this line. It is, however, worthy of note that during the year the Western Union Telegraph Company has provided for the erection of a new building in Chicago, in anticipation of increased business during the World's Fair, and has also opened up for service the new quarters in the main building at 195 Broadway, New York City. These quarters were fully described in THE ELECTRICAL WORLD at the time (xix., 69, 138). The Postal Telegraph Company has also provided for the erection of a new building in New York City (xx., 101). As complete an equipment of a Western Union telegraph office as can be found is probably that completed and put in service during the year at Nashville, Tenn. (xx., 131). The discussion of government telegraphs has of course been continued during 1892, the agitation being kept up under the lead of Postmaster-General Wanamaker. The results sought for are, however, no nearer than at the beginning of the year. In this connection should be mentioned the death of Jay Gould and its bearing on the value of Western Union stock, as was fully described in our columns at the time (xx., 380).

A BOQUET FOR ——

The most important event in connection with the telephone industry during the year has been, of course, the opening of the long-distance line between New York and Chicago (xx., 272), when Alexander Graham Bell, at the New York end of the line, conversed with representatives of the company nearly 1,000 miles away on the shores of Lake Michigan. Immediately after the opening of this line satisfactory conversation was carried on between New York and Milwaukee. An automatic telephone exchange that has received much prominence was described in our columns (xx., 99). Perhaps the most interesting use of the telephone that has come to our notice during the year is that proposed by Mr. R. L. Garner, who has taken the telephone and phonograph with him on his trip to Africa for the purpose of studying the speech of monkeys (xx., 53).

The electric lighting business of the country cannot be said to have made any great advances during the year. This is doubtless due to the unsettled condition of affairs brought about by the litigation over the Edison incandescent lamp patent. The business has, however, remained upon a substantial basis, and whatever advances have been made have been in the line of better and more durable construction and in more economic methods of equipment and operation. The year has been noted, however, for some special displays made by means of the electric light. Among these may be mentioned that at the Actors' Fund Fair in New York City (xix., 337), at the Columbian Celebration in New York City (xix., 256), and at the dedication ceremonies at the opening of the World's Fair buildings in Chicago (xix., 273). The most comprehensive paper presented during the year on the financial aspects of electric lighting was that by Erastus Wiman before the National Electric Light Association (xix., 168). Considerable discussion has been carried on regarding the well-worn subject of the grounding of the neutral conductor in the three-wire system (xix., 210), but the problem remains as much in dispute as before. Among the most notable new stations of the year may be mentioned that of the Edison Electric Illuminating Company in New York City (xix., 143), where a number of radical changes have been made in the methods of generating current for lighting and power purposes. An excellent test of an arc light station was made during the year, and published in our columns (xx., 164). The lighting of Fifth avenue in New York City by arc lamps connected to the low tension mains (xx., 160) is to be regarded as one of the most important installations of the year. Mr. C. J. Field has contributed another of his excellent papers treating of the construction and operation of a central power station (xx., 427). The only paper of importance published during the year on the lighting of trains by electricity is that which appeared in THE ELECTRICAL WORLD (xx., 435), describing the Silvey system of lighting by means of storage batteries. Prof. George Forbes, of London, in a brief paper (xx., 121) has called attention to the possible utilization of refuse matter for the production of electric current.



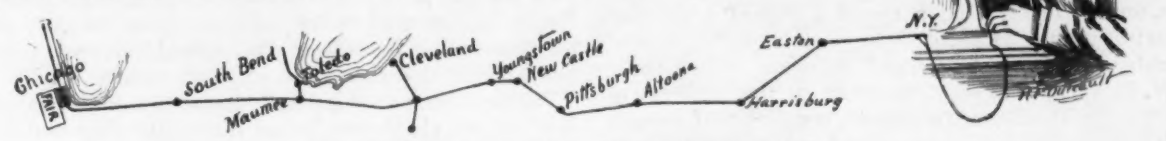
"THE COMBINE."

The underwriters have again brought up the annual discussion of fire risks in electric lighting, and a number of papers treating on both sides of the question have appeared in our columns (xx., 51, 83, 85, 98, 99, 122, 129, 132, 189, 191 and 221).

The study of the life and efficiency of the incandescent electric lamp has been carried on during the year by a number of investigators, with admirable results. The paper of Prof. B. F. Thomas on this subject, read at the Chicago meeting of the American Institute (xx., 42), was of the highest importance and gave rise to much of the subsequent discussion. Another paper of the greatest importance, and involving an immense amount of painstaking labor, was that by Mr. P. G. Gossler (xx., 175, 217). Mention should also be made of the results of some tests by Prof. E. P. Roberts, which were published in THE ELECTRICAL WORLD (xx., 9). An admirable paper on age coating in incandescent lamps was published during the year (xx., 313), by Prof. E. L. Nichols. Other papers bearing on the life and efficiency of the electric lamp are those by Carl Hering (xx., 404), by C. P. Feldmann (xx., 395), by C. Haubtmann (xx., 309) and the miscellaneous reports made during the latter half of the year (xx., 35, 319, 403, 207, 164, 247). Mention must be made, however, of the elaborate historical review of seperable and detachable incandescent lamps made by Dr. L. K. Böhm (xx., 356), in which a description is given of every lamp of this character, from that of Grove to the new Westinghouse lamp which appeared during the year. Attention should be called to the discussion of the present condition of the incandescent lamp business, on the preceding page.

The electric light litigation has been violently and hotly contested. The year opened with the decision of Judge Wallace awaiting the confirmation of the Court of Appeals, no one being absolutely certain whether that opinion which gave the Edison people the control of the incandescent lamp would be sustained by the upper court. When the opinion, (xx., 237), was handed down, however, the expectations of nearly all those who understood the case were realized, and the control of the patent, as every one now knows, was given to the Edison people. All subsequent litigation has brought about the same results, and at the present time the Edison interests are, so far as outsiders are aware, undecided in their determination as to just what use they will make of the rights which the courts have given them. In this connection, reference should be made to the interview with a prominent electrical engineer published elsewhre in our columns.

The new Westinghouse lamp has led to very extended discussion as to its merits, and its possibilities as a method of avoiding the infringement of what was supposed to be the fundamental lamp patent. This detachable lamp has been carefully described in our columns by Dr. L. K. Böhm and others (xx., 272, 356 and 374). The close of the year finds consumers still awaiting the advent upon the market of this lamp which is now announced to be a lamp containing a certain amount of nitrogen gas. The year 1893 will doubtless see some very decided changes in the incandescent lamp business of the country. The low prices at which the Westinghouse lamp is offered, and the elaborate promises made regarding its economy and efficiency have led every one to expect that it will cut a very important figure in competition with other lamps.



THE LONG DISTANCE TELEPHONE LINE.

In no branch of applied electricity have greater advances been made than in the transmission of power. Early in the year the results of the tests made on the Frankfort-Lauffen plant were published (xix., 20). Work on the Niagara Falls power plant has been carried on uninterruptedly during the year, and much has been published regarding its details. An elaborate discussion written by Carl Hering appeared early in the year (xix., 85), and a number of articles bearing upon the subject of the transmission of power from Niagara Falls to Buffalo and Chicago appeared a little later (xix. 121, 178). As the Buffalo Convention of the National Electric Light Association was an appropriate time for bringing out discussion on this plant, a number of papers were read at that time upon different phases of the project. The paper by H. Ward Leonard upon the transmission by alternating currents and the utilization of the energy by continuous currents (xix., 164), and the paper by Carl Hering on the transmission of power with special reference to the Frankfort plan (xix., 162), were the most important. Other papers of great importance appeared during the year, among which may be mentioned that by Dr. Louis Bell (xix., 196), by F. E. Pritchard (xix., 258), by R. H. Hunter (xix., 260), by D. C. Jackson (xix., 70), by Chas. F. Scott, describing a long distance plant in the Rocky Mountains (xix., 419), by W. F. Holt (xx., 122), and by W. C. Unwin (xx., 124 136). The transmission of power from coal fields has been thoroughly treated by an English writer, and his paper was reprinted in our columns (xx., 419, 423). A long distance plant of great importance was put in operation during the year between Tivoli and Rome, Italy, and this was fully described in our columns at the time (xx., 145). The efficiency of the Frankfort-Lauffen plant received further attention later in the year, when the official figures were given out regarding its operation. These were fully developed and commented upon in our columns by Carl Hering (xx., 8). A remarkable paper on the subject of transmission of power at high potentials was that of Elihu Thomson (xix., 214).

Alternating current phenomena have not failed to receive due attention. Much study has been made of the possibilities of high tension and high frequency alternating currents for the practical purposes of the commercial supply of light and power. The most remarkable paper on this subject was that of Nikola Tesla, published in THE ELECTRICAL WORLD in full (xix., 311), and afterward reprinted in book form. This paper was a reprint of Mr. Tesla's London lecture, and supplemented his American lecture on the same subject, which was printed in full in the columns of THE ELECTRICAL WORLD at the time of its presentation in 1891. A very full abstract of Mr. Tesla's Paris lecture on this subject was also published in our columns (xix., 211). A great deal of attention has been given to multiphase

SATISFIED WITH THE YEAR'S WORK.

current work, and this subject has brought out more literature during the year than perhaps any other one of similar commercial importance. Among the more important papers published in our columns may be mentioned those by A. Reckenzaun on multiphase transmission and distribution (xix., 351, 397, and xx., 58), by C. P. Steinmetz (xx., 36), by Rankin Kennedy (xx., 210), by Oscar von Miller (xx., 143,149), by C. E. L. Brown (xx., 114), by Carl Hering (xix., 84), and a description of the first central station operated by the three-phase current (xix., 276, 330), as well as the contributions of Dobrowolsky (xx., 4) and J. F. Kelly (xx. 36). The status of the drehstrom patent has been discussed in our columns by Nikola Tesla (xx.,222), by Rankin Kennedy (xx., 324,372), and by J. F. Kelly (xx.,266). The literature of the transformer has received some very valuable contributions, among them being a report of tests of a Westinghouse transformer by John Hopkinson (xx., 40, 57), tests of a Stanley transformer by Harris J. Ryan (xx., 206), a paper by W. E. Ayrton and W. E. Sumpner on the efficiency of transformers at different frequencies (xx.. 226, 243), a paper on the measurement of hysteresis and eddy current losses in transformers by S. Evershed and E. B. Vignoles (xx., 246, 263), by Dr. J. A. Fleming (xx., 413), H. A. Rowland (xx., 20, 368), L. B. Stillwell (xix., 161), and Dobrowolsky (xix., 339, 382)

The electric railway industry, now by far the largest of all the practical applications of electricity, has had an unprecedented growth during the year 1892. In all parts of the country horse railroads have been changed to electrical, those formerly equipped with electricity have been extended, and in some instances even steam roads and those operated by cable have been changed to electric roads. As might be expected, the overhead trolley system has been the one which has been the most favored. The storage battery system has been proposed for a number of new installations, and its operation on new existing roads has been the subject of some discussion, (xix., 58, 90, 431). The year has been signalized by the entrance of the trolley system into New York City. The first power station for supplying current to this line within the city limits has been described in our columns (xx., 115, 146, 192, 221). Just at the close of the year a franchise was granted permitting the use of the trolley on Manhattan Island and doubtless before the close of another year other franchises for similar lines will be granted for districts in the heart of the city. A phenomenon of street railway operation which has often been noticed, but which has received very little careful attention, was described during the year by Prof. Geo. D. Shepardson in an article on the bucking of street railway motors (xx. 160). A very careful paper appeared in our columns, written by Prof. E. P. Roberts, discussing the central station as the important factor in electric railway systems (xx., 358). A number of articles have appeared discussing different phases of the operation of the City & South London Electric Railway, among which the most important are those by Edward Hopkinson (xx., 38) and Alexander Siemens (xx., 134). By far the most elaborate test of an electric road that has ever been made was that conducted by Hermann S. Hering and W. S. Aldrich, of Johns Hopkins University, and reported in a number of consecutive issues of The Electrical World. This series of articles was afterward reprinted in pamphlet form and contained as much matter as a single 16-page issue of The Electrical World. Three important railway papers, read before the American Institute of Electrical Engineers at its Chicago meeting, by H. Ward Leonard, Cary T. Hutchinson and Nelson W. Perry, were printed in full in our columns during the year. One of these, that on series electric traction, created considerable subsequent discussion, carried on by its author, Nelson W. Perry (xx., 359, 407) and Cary T. Hutchinson (xx., 328, 368).

The West End Street Railway of Boston has continued to give elaborate reports of its operating expenses, which are up to date the best that have been published on this subject (xx., 121, 149, 829). The Chicago & St. Louis Electric Railway, which has continued to attract attention during the year, because of the novelty and boldness of the project, has received the attention in our columns which its prominence and importance as a commendable undertaking has warranted (xix., 117, 398); xx., 2, 189, 191, 336, 504, 452).

No review of the year would, of course, be complete without mention of the consolidation of the Thomson-Houston and Edison General Electric Companies. This combine, which occurred early in the year, was noticed and commented on in our columns (xix., 100), and has since played an important part in the progress of the electrical industry. Its position at the close of the year is undoubtedly a very strong one in the electrical field.

Among the most prominent miscellaneous subjects that have attracted considerable attention during the year may be mentioned the technical education of the electrical engineer (xix., 418, 438). The carrying forward of plans for the electrical display at the World's Fair has been a subject of almost constant comment in our columns during 1892, and a great deal of space has been given up to this subject, which we have regarded of great interest to all of our readers, whether they are prospective exhibitors or prospective visitors. Reference to the indexes to our two volumes will show a very complete treatment of the progress of preparations on the Electricity Building and in the arrangements for the electrical exhibits.

On Inert Gases in Incandescent Lamps.

BY DR. L. K. BÖHM.

During the early stage of experiments in incandescent lighting the great obstacle to the perfection of a commercial lamp was the instability of the carbons, these burning out within a few hours. The lamps were at that time never fully airtight, and consequently the oxygen of the air consumed the carbon. To remedy this some of the lamps, for instance Konn's lamp (1875) had five carbon rods. The lamp was exhausted and fairly tight, and it was reasoned that the oxygen of the residual air in the globe would only consume the first carbon rod, and the carbon monoxide formed would make the other carbon rods last; and as by this formation of an inert gas the difference of pressure between the space inside the globe and the surrounding atmosphere was lessened, there was not so much danger that more fresh air would rush in.

The first carbon rod generally lasted 15 minutes and the four others about two hours; that is the lamp with five carbon rods lasted about eight hours, which was sufficient for one night. Fontaine used in his experiments carbon rods from Gaudain, the best make that could be obtained about 1876; they were 1.6 millimetres in diameter and lasted on an average 15 minutes when from 15 to 18 millimetres of the rod were incandescent and about 10 carcel burners of light was emitted.

The deficiencies of these lamps were apparent and the remedy could be sought in two directions. First, the lamps should be made airtight in order to prevent the air from rushing in after they were exhausted, or, second, the air in the lamps could be replaced by an artificial atmosphere of inert gases incapable of combining chemically with carbon and thus preventing the consumption of the same.

We have seen that the oxygen of the residual air in Konn's lamp consumed the first carbon rod in about 15 minutes and that the four others lasted about two hours each, burning then in an artificial atmosphere of carbon monoxide. Old publications speak of the formation of carbon dioxide or, as it is generally called, carbonic acid gas, but this is an erroneous statement, because in the presence of such a large excess of carbon in comparison with the oxygen only carbon monoxide can be formed.

Some time later, in 1878, Sawyer and Man made experiments with different gases in order to see what might be the most suitable artificial atmosphere in the lamp. They burned carbon rods in an atmosphere of ordinary illuminating gas which contained principally hydrocarbons. These experiments led to the hydrocarbon treatment or flashing process. The hydrocarbons in the illuminating gas were decomposed by the electric current and carbon was deposited on the rod, thus decreasing the resistance of the same. Consequently a light of uniform candle power cannot be obtained with carbon in a permanent hydrocarbon atmosphere; as the voltage decreases, the ampèrage rises, and the candle power increases until the carbon, being overworked, breaks. This is the case when the source of electricity furnishes the sufficient number of ampères.

If, however, the dynamo is of low ampèrage, like an arc light machine—say it furnishes 10 ampères—then the light will diminish in candle power when the voltage drops, and the ampèrage can no more increase, because the number of watts acting on the carbon rod is getting smaller until the rod is only red, when there will not be sufficient heat to decompose more hydrocarbon. These old-time carbon rods needed about 10 ampères to become incandescent. Sawyer and Man found that the incandescence of the carbon conductor decreased in a hydrocarbon atmosphere, while every one in the flashing room of a modern lamp factory knows that the light is increasing in candle power while the filament is treated in the hydrocarbon atmosphere. Sawyer and Man certainly were correct in their observations and I explain this apparent contradiction as above stated. Sawyer and Man further observed that the incandescence remained much higher when the lamp was exhausted because an additional deposit of carbon could not then be made and the artificial atmosphere, perhaps a little too dense, was removed. This, with the flying round atomic carbon particles, acts in an incandescent lamp toward the light rays as fog does in the natural atmosphere toward the rays of the sun.

The same experimenters also introduced hydrogen into the lamps. They found this gas to be in some respects advantageous for an artificial atmosphere but abandoned its use later on in favor of nitrogen gas, which they employed more extensively in their further experiments; but it may be safely said that lamps filled with nitrogen were never introduced into practice; they remained confined to the laboratories.

Next to this came the present commercial lamp, which solved the problem in the other way. There is no artificial atmosphere in it, but it is highly exhausted and perfectly airtight.

On April 29, 1884, Edison had a patent granted to him for a lamp with an artificial atmosphere of carbon monoxide. The claim reads:

> The sealed globe of an incandescent electric lamp provided with a residual atmosphere consisting almost entirely of carbon-monoxide, substantially as set forth.

There is the same gas in the lamp as Konn used in his, but in one instance the carbon monoxide was produced in the lamp by consuming one carbon rod by the oxygen of the residual air, while in the other instance carbon monoxide was produced outside and introduced in the lamp after evacuation.

I t is said now that the new Westinghouse lamp, the separable lamp will be filled with nitrogen.

These are about the most important experiments with artificial atmospheres. As already stated, if such an artificial atmosphere is a little too dense then it acts like fog in nature. Further gases in a lamp conduct the heat from the carbon to the glass walls, so that such lamps get too hot, an inconvenience which will be noticed especially in summer. But the greatest objectionable feature to artificial atmospheres is the waste expenditure of energy. The energy used in heating up these inert gases is lost for the production of light and, as this loss occurs in every lamp, it amounts to a great deal more than any one would suppose. These objections to artificial atmospheres hold good for all sorts of lamps. The second-named point, viz., the conduction of heat to the glass walls, is, however, especially bad for separable lamps. These detachable lamps have an airtight ground joint, and between the male and female part there is put a special cement or prepared beeswax. If now such a cement softens by heat it will admit air, if on the contrary it hardens by heat, it will crack slightly and will also admit air, and that means consumption of the carbon. A separable lamp ought to be more highly exhausted than a lamp sealed by fusion, in order to prevent the heat of the carbon from being conducted by the residual air to the ground joint. An artificial atmosphere is, of course, worse than a poor vacuum.

Of all these artificial atmospheres Edison's carbon monoxide stands best scientific reasoning, although Edison ought to have known by that time that artificial atmospheres are detrimental to lamps. In case there should be a trace of oxygen left in the lamp the carbon monoxide—it may be plausibly reasoned—would combine with it and form carbon dioxide, but it is not so, the monoxide only is formed, owing to the excess of carbon present, as above stated.

The ideal thing for an incandescent lamp is a vacuum as high as it possibly can be attained. The higher the vacuum the more we approach that condition which exists in space and through which the rays of the sun pass so admirably. All inventors who experimented with artificial atmospheres dropped the subject and there is no such lamp in practical use at present and the announcement of the Westinghouse company to put on the market a detachable lamp filled with nitrogen sounds rather singular after all the experiments made by various inventors with artificial atmospheres.

Progress of the Chicago & St. Louis Electric Railway.

Work on this gigantic project is progressing as rapidly as the weather will permit. A few weeks ago grading was commenced at Edinburg, 80 miles from St. Louis, and pushed in both directions. At present 21 miles have been completed. The first power house, a cut of which was shown in The Electrical World of June 11, 1892, has been completed some time. In this will be installed 10,000 horse power of boilers, divided up between the Babcock & Wilcox, the Heine, the Stirling, and perhaps some other makes. All of these will be equipped with the Hawley down draft device for smoke consuming purposes. A second power house of equal capacity, 130 by 210 feet ground area and two stories high, is already well under way at Fairbury, Ill. The work of grading from the Chicago end of the line will commence this week. In the work already under way 400 wagons are employed, and by next week the number will be increased to 600.

A proposition has just been received from the city of Bloomington, Ill., offering to donate to the Chicago & St. Louis Electric Railway Company the sum of $150,000 if the company will build a spur from its main line to that city and establish a power station there. This spur would be about 10 miles long.

It is the present intention of this company to use its two tracks between the hours of 6 A. M. and 9 P. M. exclusively for passenger traffic, and from 9 P. M. to 6 A. M. for freight purposes. Eventually there will be four tracks, so that freight and passengers may be carried simultaneously.

Priority of Invention.

Now that a 64-inch spark has been produced by Prof. Elihu Thomson here in this country, we will probably hear from across the water, as in the case of the Tesla and other researches, that some one over there did the same thing long ago, away back in the year —— A. D., or if they did not, they would have if they had had the apparatus, or some such feeble excuse; or if all other attempts to claim priority fail, perhaps some one will resort to the bully's excuse of saying, "That's nothing, I could have done it if I had wanted to." But perhaps the nearest they can come to it, this time, is to claim that Prof. Thomson was in England when he was an infant.

The Cologne Municipal Lighting Station—I.

BY CLARENCE P. FELDMANN.

The Cologne station shows some features differing so much from all others which have been erected that a technical description of its details may be of interest.

The station was planned as early as 1887, and the necessary funds were granted in February, 1888. Tenders were received from Messrs. Siemens & Halske, of Berlin; S. Schuckert & Company, of Nuremberg, and the Helios Company, limited, of Ehrenfeld, near Cologne. After a thorough examination of the proposals, Mr. A. Hegener, then manager of the Municipal Gas and Waterworks, recommended to accept the latter tender, which was for an alternating current station with transformers. On the 13th of February, 1890, the municipality granted 1,850,000 marks;* in April, of the same year, the foundations of the station building were commenced, and on the 10th of September, 1891, the dynamos delivered current for the first time.

The supply network, Fig. 1, was calculated for a minimum output of 20,000 16 c. p. lamps burning simultaneously. This network is one of the few which was really calculated, the calculations being made by the method of "sectioning," which Messrs. J. Herzog and L. Stark, of Budapest,† published two years ago. The probable distribution of lamps was included in the specifications for tenders, from which the network was then planned by Mr. Herzog. The cross-sections of the cables were chosen before hand and the current distribution was then evaluated ten simultaneous equations with ten unknowns being put down for the ten meshes of the network. By chance not one of the points where the sections had been made were real "cutting points" as may be seen in Fig. 1, but although they had been chosen wrong they gave the real current distribution without any further calculations. This real distribution at a time when all the given consumption currents were taken simultaneously is shown in Fig. 2. When the computation had been completed for the first time, one or two of the distribution leads turned out to be loaded with more than 1,000 ampères per square inch, so some of the other leads had to be enlarged in sectional area, and the calculations had to be repeated. This second time, as could be expected, the network was nowhere carrying too strong a load, and the losses were within the admissible limits, namely, 3 per cent. in the feeding mains and 1 per cent. in the distributing network, when the 20,000 lamps were simultaneously burning. The values of of ten unknowns were:

A =	91.0 ampères	G =	41.2 ampères
B =	92.5 "	H =	5.3 "
C =	107.0 "	L =	18.3 "
D =	83.2 "	M =	21.5 "
F =	11.1 "	P =	80.2 "

The total losses are from it to a ..... 23.7 volts = 1.19%
" " " " b ..... 20.3 " = 1.01"
" " " " c ..... 19.2 " = 0.96"
" " " " d ..... 19.0 " = 0.95'.

Nearly 20,000 metres of concentric cable of sections ranging from 220 square millimetres down to 50 and 25 square millimetres have been buried about two and a half feet below the sidewalks, and practice has proved all the conclusions drawn from this theoretical predetermination which requires only some patience and good, common sense, but no high mathematics.

The concentric cables, Fig. 3, which were furnished by the Société d'Exploitation des Câbles Electriques (Système Berthoud, Borel et Cie., of Cortaillod, Switzerland, had all been tested with 5,000 volts from an alternating current dynamo (not from an influence machine) and were placed in wooden troughs (Fig. 3) which were afterward filled with molten asphalt and covered with a layer of bricks and sand. The cables themselves contain two concentric leads and an insulation of some paper mass of 6 millimetres thickness between the interior and the concentric conductor and between the latter and the exterior lead cover, each of these layers of insulation itself being protected against humidity by a special lead covering, and the whole cable being protected against mechanical injuries by means of an iron sheathing.

From the central station three main cables of 220 square millimetres sectional area for each conductor, or of a total section of 2×220 square millimetres, run to a public building near the centre of greatest consumption. By means of double poled mercury switches (Fig. 4) which may be handled without any danger by means of a toothed bar and a ratchet wheel, each of these cables in case of necessary repairs may be disconnected at the station or at the end in said public building. Similarly the five distributing mains of 2 × 185 and 2 × 120 square millimetres section, respectively, may be disconnected at twelve points, thus enabling repairs and house connections to be made at any time without disturbing too great a district. The smaller distributing leads have not been connected at both of their ends, and as they thus never form closed meshes, it is impossible to overheat any one of these leads, whose sectional area varies between 2 × 50 and 2 × 25 square millimetres.

As some of these cables feed a rather large number of transformers, their disconnection, even in day time, means are duction of the current going out; therefore, such an operation is first announced to the station by means of a telephone. The two metallic leads of these telephones are laid next to, and at the same time with, the lighting cable. Seven thousand metres of this telephone cable have been put down, and not the least "humming" disturbs the telephonic intercourse between the station and these switching sub-stations. Fig. 5 shows one of these disconnecting stations for only two cables and containing the telephone; the clock shown has been, however, omitted on those used at Cologne, but at the Amsterdam station it has been added as shown.

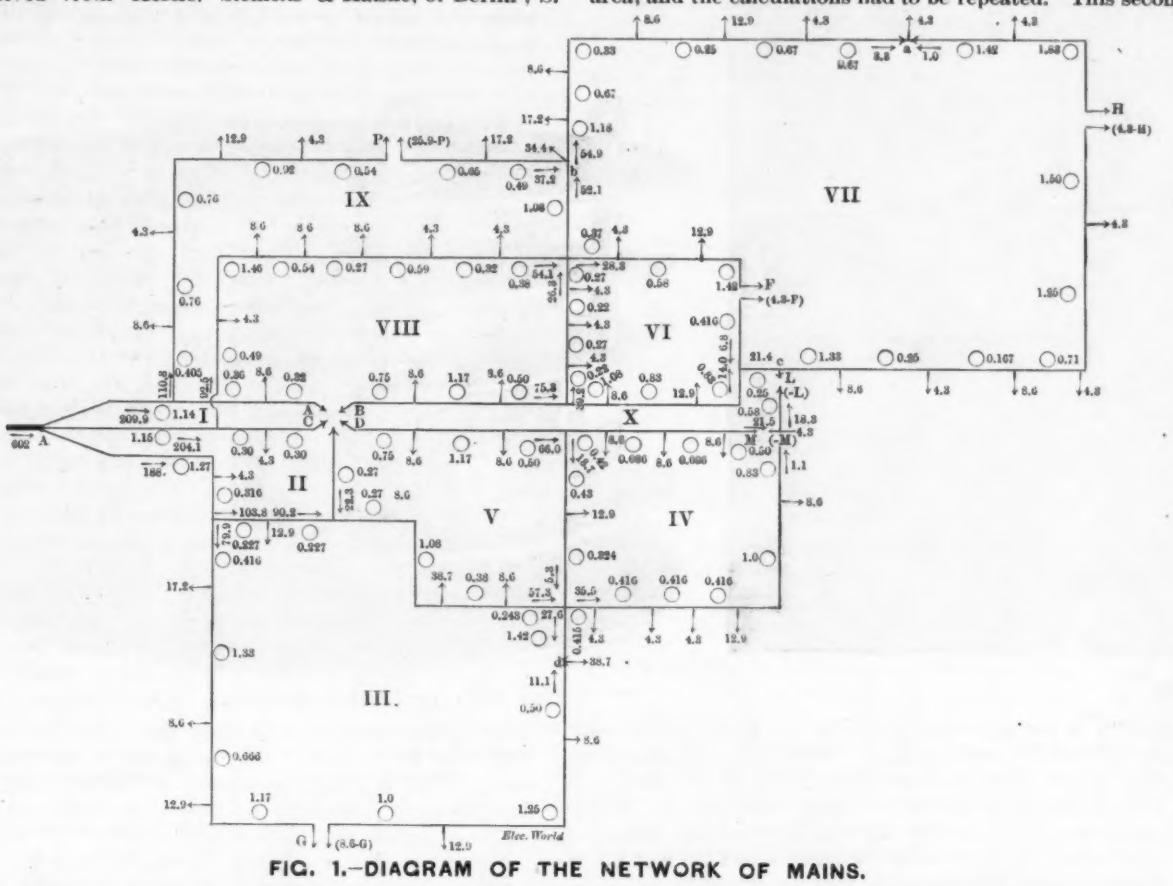


FIG. 1.—DIAGRAM OF THE NETWORK OF MAINS.

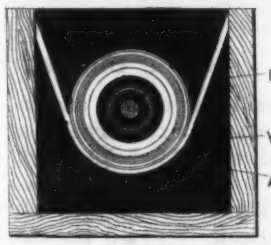
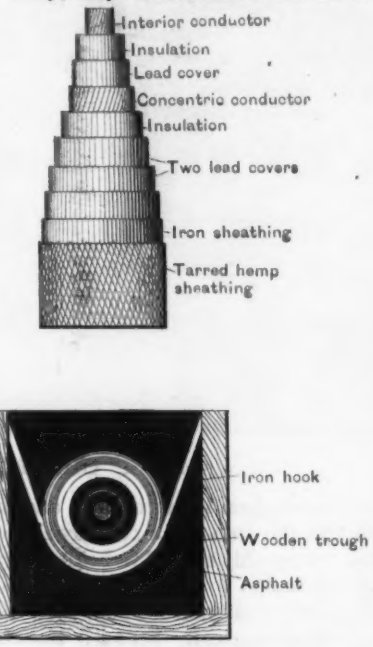


FIG. 3.—UNDERGROUND CABLES AND TROUGHS.



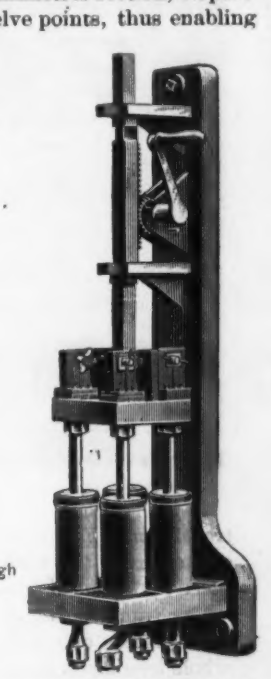


FIG. 4.—DOUBLE POLE HIGH TENSION MERCURY SWITCH.

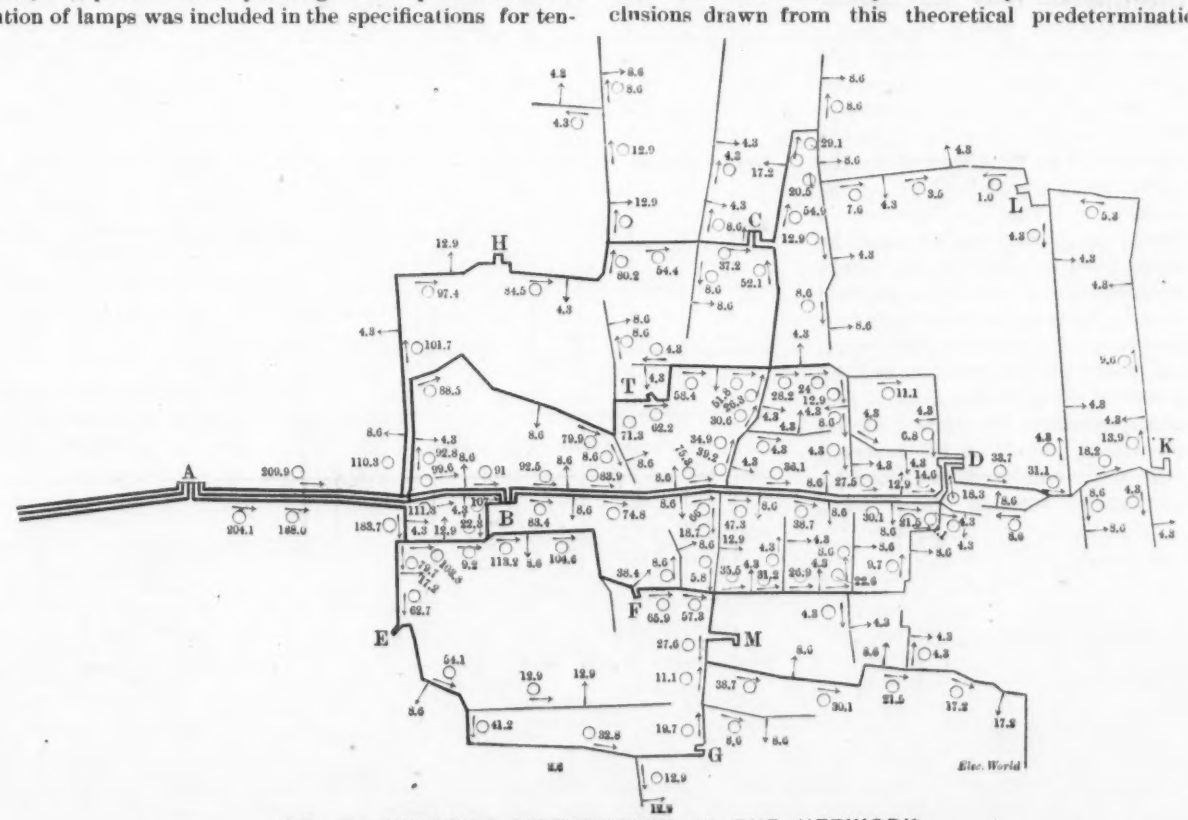


FIG. 2.—CURRENT DISTRBUTION IN THE NETWORK.

ne arrows vertical to the conductors signify consumers' currents, while those parallel to the conductors indicate the load currents passing through those conductors.

FIG. 5.—DISCONNECTING STATION.

*One dollar is equal to about 4 marks, or more exactly one mark is equal to 23.6 cents.

†J. Herzog and L. Stark, THE ELECTRICAL WORLD, vol. xv., p. 300, May 3, 1890. Also vol. xvi., p. 118, Aug. 23, 1890.

The way in which a house connection is made is shown by Fig. 6. The concentric cable is tapped near the house, a T joint, filled with a special insulating mass furnished by Messrs. Berthoud, Borel et Cie., connects the main cable to another length of concentric cable, 25 square millimetres in section, which enters the cellars, and, terminating in suitable end joints, is connected to the primary circuit of the transformer by means of the wires shown in Fig. 7. The

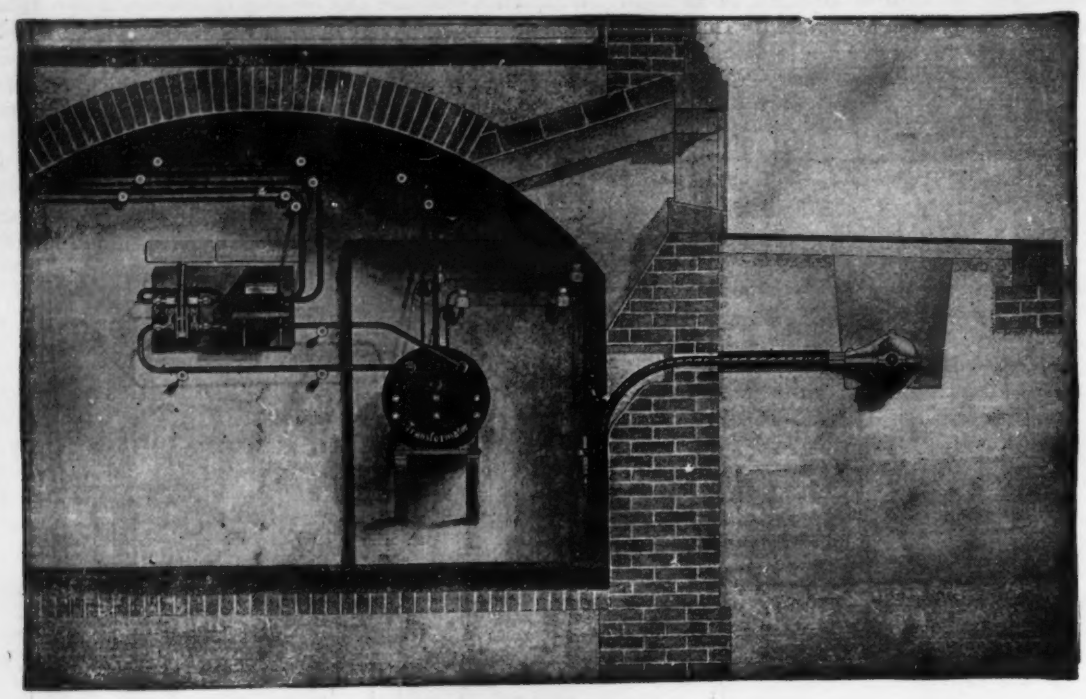


FIG. 6.—HOUSE CONNECTION.

transformer (Fig. 7) is placed upon an iron base, and insulated from the wall and the iron by a suitably shaped piece of dry hard wood, thoroughly soaked in boiling wax.

The transformer, shown in Fig. 7 is built of E shaped iron sheets one and a half millimetre thick, and the whole iron block is placed eccentrically between circular side plates in such a way that it may be easily rolled about and that the terminals are always at the top. The two primary terminals contain the primary fuses invented by Mr. T. O. Bláthy, which fuse without allowing an arc top form. From the free ends of the two secondary coils and from the point where they are connected in series three stout copper bars carefully insulated pass through one of the side plates, ending in screw threads and large nuts with

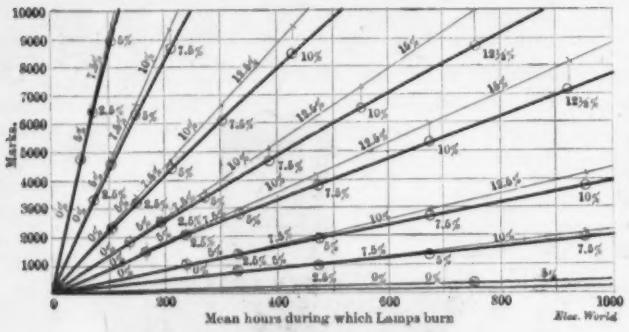


FIG. 10.—SCALE OF REBATES.

loose cones that are split at several points. These three secondary terminals offer a splendid means to connect the house leads in a solid manner to the transformer without any soldering. Each of the secondary coils furnishes 36 volts, the two in series thus giving 72 volts. This somewhat exceptionally high tension was chosen by the Helios company, because their alternating current arc lamps burn perfectly steady, and with an arc of 3 to 4 millimetres on a 36-volt circuit. At the terminals these 12 or 16 ampère lamps then have between 28 and 30 volts, the remaining 6 or 8 volts being consumed in a resistance. Most of the arcs are run at 36 volts, thus requiring a three wire system, which is, however, generally separated from the two wire system, which feeds the incandescent lamps at 72 volts. For large buildings transformers of 2 × 55, or 110 volts, are allowed to be used.

There exists, strictly speaking, no secondary network, as the transformers are generally placed in the cellar of any house where they may be required. But as the smallest type of transformer is for 1,250 watts (the other usual types being 2,500, 5,000, 10,000 and 25,000 watts), sometimes the necessity arises to supply two or three neighboring houses from one transformer. The consumer only pays for the connection from his house to the network, including the T joint, although the cable and T joint remain the property of the municipality. No rents or fees are paid for the transformers.

The annual rents paid for electric meters increase with an increasing number of the lamps connected. They are plotted in the accompanying Fig. 8, which at the same time shows the meter rents for some other German cities, viz., Berlin, Barmen, Dusseldorf, Elberfeld and Mühlhausen. As may be seen from this graphical table, the Cologne rents are nearly always midway between the others, of which those of Barmen are the highest, and those of Elberfeld the lowest, a remarkable instance for those two adjacent but rival towns.

The annual rents for the meters are as follows:

Up to 10	16 c. p. lamps	12 marks.
From 11 to 25	" "	15 "
From 26 to 50	" "	21 "
From 51 to 125	" "	30 "
From 126 to 250	" "	48 "
From 251 to 400	" "	66 "
From 401 to 500	" "	84 "
From 501 to 625	" "	105 "
From 626 to 759	" "	120 "

The electric meter which is so far exclusively used is the Bláthy meter. It consists of two magnetic fields displaced by one quarter of a period and acting upon a rotating aluminium disc at points displaced by one-quarter of the disc's circumference from one another. When the main field is at a maximum magnetization, the shunt field just passes through zero magnetization and produces in the disc powerful eddy currents moving in such a direction as to be attracted by the main field, which is there at its maximum. One quarter of a period or $\frac{1}{200}$ of a second later the shunt field reaches its maximum magnetization, while the main field is at zero and produces an eddy current in such a direction that repulsion takes place between it and the powerful shunt field. As this process is repeated 200 times a second (for the 50 periods or 100 reversals which are employed at Cologne) a continuous rotation takes place, which, over a very great range, is directly proportional to the current passing through the coils of the main field.

The adjustment is made in such a way that with the hundred ampère meter one ampère minute gives two revolutions, and with the two hundred ampère meters one ampère minute corresponds to one revolution per minute. As these meters start with less than one ampère the lowest number of revolutions is one per minute for half an ampère, or one ampère respectively, and the highest is 200 for 100 ampères, or 200 ampères respectively. Together with Mr. F. Uppenborn, of Berlin, I lately tested one of these 100 ampère meters and found that instead of 30.0 seconds the meter used 30.8 seconds for n revolutions, when n ampères were passing through its main coils. The adjustment, of course, was not yet completed, but the difference between each of the readings was about 0.5 second or 1.3 per cent between 1 and 100 ampères.

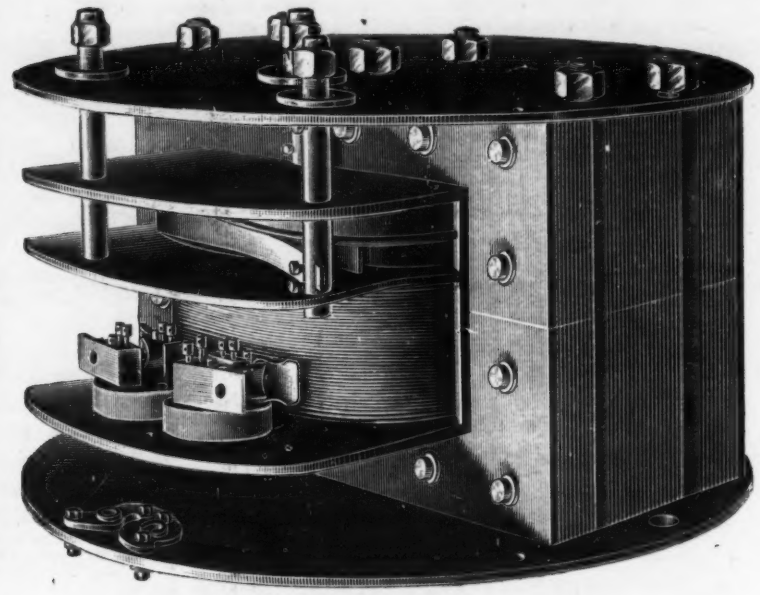


FIG. 7.—TRANSFORMER.

The following table will show the results of the tests more in detail:

Observed values. Ampères.	Revolutions in seconds.		Calculated values. Ampères.	Revolutions in seconds.	Deviation from 30.8.
1.00	1	32.4	1	32.4	1.6
1.92	2	33.2	2	31.9	1.1
3.66	4	33.5	4	30.7	0.1
5.76	6	32.9	6	31.5	0.7
7.70	8	32.0	8	30.8	0.0
8.65	9	32.25	9	31.0	0.2
9.52	10	32.2	10	30.7	0.1
9.52	10	32.0	10	31.4	0.4
15.47	16	31.5	16	30.5	0.5
15.68	16	30.7	16	30.1	0.7
20.00	20	30.4	20	30.4	0.4
24.75	25	30.4	25	30.0	0.8
29.80	30	30.1	30	29.9	0.9
60.	60	30.8	60	30.8	0.0
100.	100	30.8	100	30.8	0.0
100.	100	31.4	100	31.4	0.6
			Mean values....	30.8	0.5

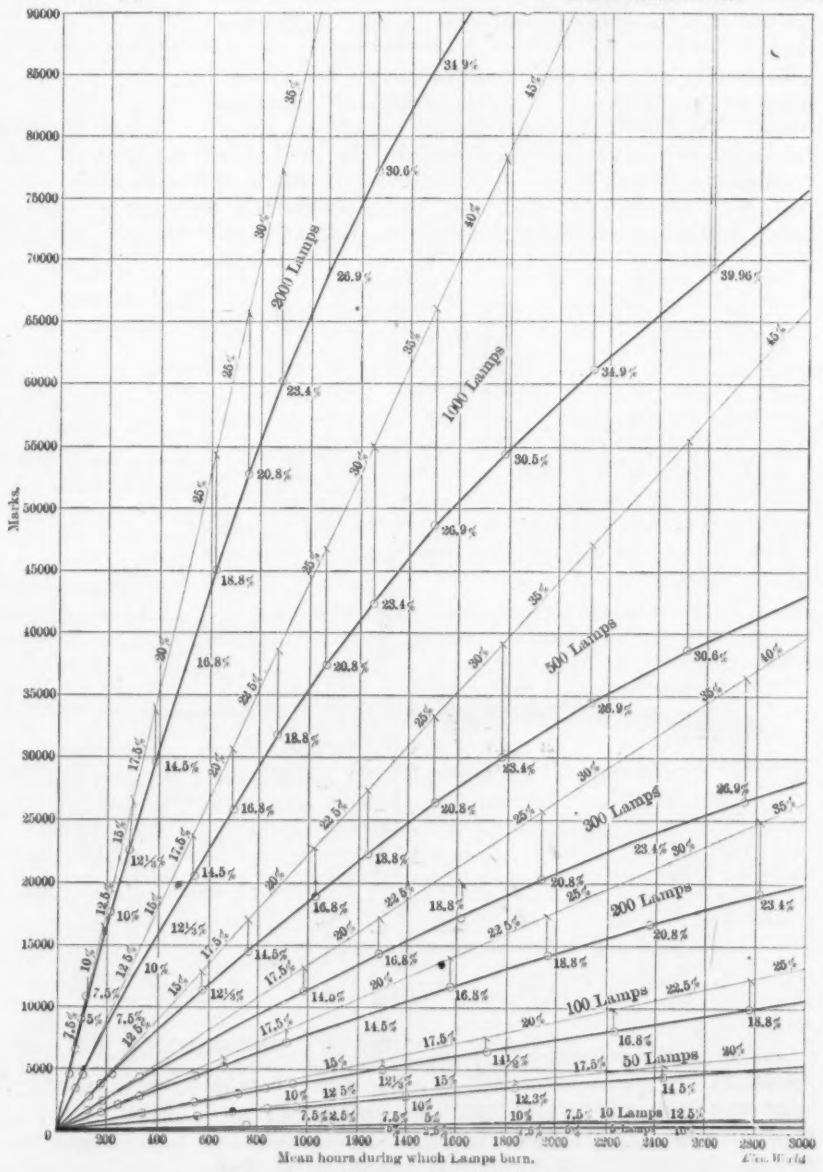


FIG. 9.—SCALE OF REBATES.

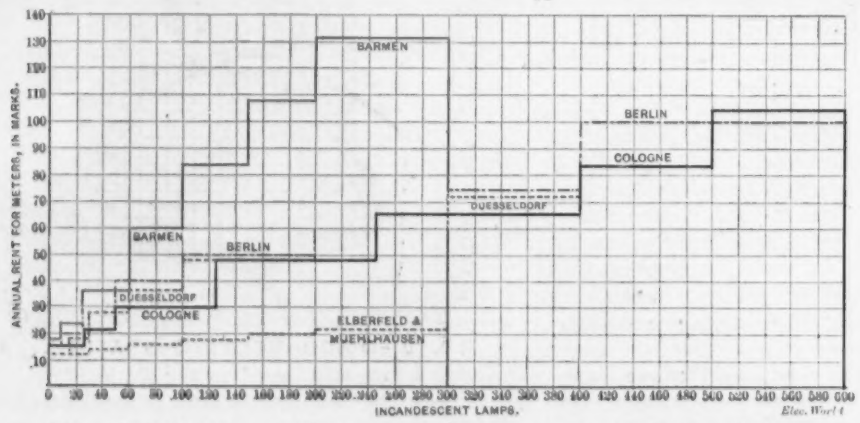


FIG. 8.—ANNUAL RENTS FOR METERS IN DIFFERENT CITIES.

The adjustment is made by means of a permanent magnet which, when inserted so as to cover more or less of the disc's surface, produces a third set of more or less powerful eddy currents, which impede the disc's revolution more or less. The counting mechanism registers ampère hours, or for a constant tension watt hours, and it is one of its most valuable properties that it records real watts even for arc

lamps or motors, where the apparent watts may be much greater than those measured with a wattmeter or one of those methods described by Potieo in 1881 or Ayrton in 1889, and others.

The price charged for 100 watt hours, as regulated by the meter, is 8 pfennigs (or about 2 cents), which makes 4.4 pfennigs, or a little over one cent, per 16 c. p. lamp hour, assuming the lamp to require 3½ watts per candle. To large consumers there is, of course, a rebate, which increases with the total sum paid annually by the consumer, and with the number of burning hours of his plant. It is thus possible that a customer having few lamps in frequent use may have the same rebate as a large consumer with many lamps, of which generally only a few are burning. The scale of rebates is given in the accompanying table, and is shown graphically in Figs. 9 and 10, which will explain themselves.

TABLE OF REBATES CORRESPONDING TO FIG. 12.

					Per cent.
From	0	to	250,000	mark × hours	0
"	250,000	"	500,000	" "	5
"	500,000	"	1,000,000	" "	7.5
"	1,000,000	"	2,000,000	" "	10
"	2,000,000	"	4,000,000	" "	12.5
"	4,000,000	"	7,000,000	" "	15
"	7,500,000	"	13,000,000	" "	17.5
"	13,000,000	"	22,000,000	" "	20
"	22,000,000	"	34,000,000	" "	22.5
"	34,000,000	"	50,000,000	" "	25
"	50,000,000	"	70,000 000	" "	30
"	70,000,000	"	100,000,000	" "	35
"	100,000.000	"	140,000.000	" "	40
"	140,0 0,000	"	200,000,000	" "	45
"	200,000,000	"	and over	" "	50

(To be concluded.)

High vs. Low Frequency in Transformers.

BY LOUIS T. ROBINSON.

The following statements by Mr. H. Franklin Watts in THE ELECTRICAL WORLD of Dec. 17, page 390, seem to be somewhat peculiar and are apt to be misleading. Mr. Watts says (the italics are mine): "While it is true that by reducing the frequency we greatly reduce the rate of cutting in the converter, we must also bear in mind that we are giving the *alternations more time to act* on the iron and thus create more lines, and consequently cut more lines, so that *within certain limits* a variation of frequency may make no difference in the *output* of a converter, or even in the efficiency, provided it contains a large mass of iron. The exact limit will probably be a question of saturation or magnetic density of the cores of the converter, and as this density is very low, it would seem to indicate a larger range of frequency."

Leaving out of consideration some peculiar uses of terms, this paragraph contains some statements quite contrary to generally accepted ideas, and the impression conveyed seems to be that by placing a converter on mains supplied at different frequencies, varying within certain limits, the output and efficiency of the converter will remain unchanged, provided it contains a large mass of iron.

Supposing that the frequency proposed by Mr. Watts, namely, 35 periods, be chosen and we take a modern converter which was designed to run at a frequency of 125 periods and place it on mains at the intended voltage and at this lower frequency of 35 periods; as the iron loss in a transformer core is always present and is practically unaltered with the load, we can hardly afford to build transformers with large masses of iron, in fact some of the best transformers on the market have the amount of iron and the induction so reduced that on full load the copper loss is approximately equal to the iron loss. Let us suppose a case of a 2,500 Watt converter of 94 per cent. to 95 per cent. efficiency at 125 periods, and at full load call the copper loss 50 and the iron loss 100 (this being a case rather favoring the large mass of iron than otherwise) and let us examine what takes place in running this first at its intended voltage, and second at its intended induction on mains supplied at 35 periods as proposed. Placing this converter on the usual voltage we have raised the induction in the iron from 5,000 (a good value) to 16,400 and increased our iron loss in the ratio of

$$\frac{5{,}000^{1.6} \times 125}{16{,}400^{1.6} \times 35} \text{ or } \frac{1}{1.87} \text{ nearly,}$$

and having in the first instance assumed 100 watts we now have 187 watts iron loss.

These values are calculated, using Mr. Steinmetz's law that the loss in a given mass of iron is, at the same frequency, proportional to the 1.6 power of the induction, and the reduction is made for the correspondingly reduced frequency. The copper losses will, neglecting the larger constant copper loss due to the increased magnetizing current, remain constant and the drop and output remain the same. The eddy current loss in the cores may be less, but as this is a small factor and we have a larger constant copper loss, we will leave out both these factors and be near enough for the present needs.

Now let us arrange our losses and efficiencies at quarter, half and full load in the two cases:

AT 125 PERIODS.		AT 35 PERIODS.	
Total loss	150 watts	Total loss	237 watts
Copper loss	50 "	Copper loss	50 "
Iron loss	100 "	Iron loss	187 "
Efficiency at quarter load	85 %	Efficiency at quarter load	76 %
" half "	91 %	" half "	85.4%
" full "	94.4%	" full "	91.5%

Which makes quite a difference in the all-day efficiency, to say nothing of the excessive heating which would probably take place.

Let us now turn to the second case and see what happens. We take again the same transformer and lower the induction to its original value and place it on mains of the proper voltage to secure this at 35 periods. First let us ascertain what these voltages will be. We know that the E. M. F. of a transformer may be expressed as follows:

$$\text{E M F} = \frac{4 \times \text{area} \times \text{turns} \times \text{induction} \times \text{frequency} \times \frac{2}{10}}{10^8}$$

using centimetre measures and absolute units of induction. We can use either the primary or secondary turns and obtain the corresponding E. M. F.

We see here that the induction remaining constant we will have the E.M. F. directly proportional to the frequency, so that we must now run the transformer, if originally designed for 1,000 and 100 volts, at 280 and 28 respectively, or else change our windings, which would not alter the losses.

We have now (retaining the same current density in our copper and the same drop) reduced the output of the converter to 700 watts. Our copper loss remains the same as before, 50 watts, and our iron loss is reduced to 28 watts on full load. We will leave out the eddy current and constant copper loss as before and compare as follows:

AT 125 PERIODS.			
Total loss	150 watts	Efficiency at ¼ load	85 %
Copper "	50 "	" " ½ "	91 %
Iron "	100 "	" " full "	94.4%

AT 35 PERIODS.			
Total loss	78 watts	Efficiency at ¼ load	81.5%
Copper "	50 "	" " ½ "	87.0%
Iron "	28 "	" " full "	90.2%

In addition to having lowered the efficiency materially, we have reduced the output to less than one-third of what it was before.

To retain the initial efficiency and all other things equal, we must by the best arrangement of induction and losses make a larger converter than we would use in a moderate frequency, and after possibly having obtained such a transformer, leaving it entirely unaltered, we can materially decrease the constant losses by raising the frequency to usual, or even higher, values. Recently published tests by Prof. Ayrton show this quite clearly.

While we may need at this stage of electrical development alternators for low frequency, basing our needs on every consideration other than that relating to converters, there is no doubt that, all other things being equal, we can obtain a greater output at a higher efficiency from a given weight of copper and iron by raising even the present high frequencies in use, and while this may be a branch of the general problem which should be passed over, owing to other matters being of more importance, it seems hardly fair to assume that the output and efficiency of the converters will remain unaltered by changing the frequency.

Regulation Test of the Ryan Special Series Motor.*

BY W. L. BLISS.

In the October number of the *Journal* appeared an article on "A Method for Balancing Armature Reactions," by Prof. Harris J. Ryan.† The subject of armature reactions has received much study and attention of late years, but as yet, with this single exception, no one seems to have devised a means by which their deleterious effects could be eliminated. This method was clearly outlined in the article referred to, and it was with the view of extending the investigation of the working of the machine in question and to verify the predicted results that the present test was undertaken.

The machine tested is of the bipolar type with cast iron field, drum armature and small air gap. Following are its principal dimensions:

Armature built up of iron discs.	
Diameter of armature core	6 inches
Length of armature core	6 inches
Number of grooves in armature core	64
Number of No. 12 B. & S. G. wires in each groove	6
Number of sections in armature	64
Number of turns per section	3
Number of bars in commutator	64
Number of turns on armature (total)	192
Number of wires on armature	364
Length of air gap	125 inches
Number of turns on field core	250
Size of wire on field core, No. 7 B. & S. G.	
Reaction cable consists of 8 No. 8 B. & S. G. wires.	
Number of slots in each pole face	6
Number of turns passing through each pole face = ½ number of turns on armature.	
Armature potential	100 volts
Armature current	20 amp.
Armature speed	1,600 rev. per min.

The motor was set up in the laboratory and connected by means of a belt to the Ryan-Thompson dynamo which was driven as a motor and supplied with current from the Edison mains. The first step in the test was the determination of the internal characteristic. A variable resistance was included in the field circuit together with an ammeter, the current for excitation being also supplied from the Edison mains. A voltmeter placed across the terminals of the motor served to measure the armature potential. The speed was maintained as nearly constant as possible and readings of the voltmeter were taken each time the excitation current was varied. From this experiment the following data were secured:

*From the *Sibley Journal of Engineering.*

†See THE ELECTRICAL WORLD, Nov. 19, 1892. See also a paper read before the American Institute of Electrical Engineers, by Prof. Ryan, entitled, "On the Relation of the Air Gap and Shape of the Poles to the Performance of Dynamo Electric Machinery," and published in THE ELECTRICAL WORLD Oct. 3, 1891. The principles upon which this method of compensation is based are discussed in this paper.

TABLE I.

No.	Speed.	Volts. Observed.	Volts. At 1,700 rev. per m.	Field current ampères.
1	1,680	26.5	26.8	1.25
2	1,895	37.5	35.3	2
3	1,800	48	45.3	2.95
4	1,700	58	58	3.9
5	1,700	63.5	65.5	5.2
6	1,650	73.5	75.7	6.25
7	1,640	79	81.9	7.3
8	1,660	87.5	90.1	8.5
9	1,760	95	91.8	9.3
10	1,720	99 5	98.3	10.4
11	1,680	104	105.2	11.95
12	1,480	104	119	13.7
13	1.850	123.5	113.5	14.9
14	1,810	135	126.8	18

When these results are plotted it is seen that the characteristic curves very gradually and does not contain the "knee," which is peculiar to most magnetization curves. This, however, is due to the fact that the field consists of cast iron and that the air gap is exceedingly small. In the following experiment the full meaning of this statement will be made manifest. A trial was now made in which the field excitation current was maintained constant. The Ryan-Thompson dynamo served as a load for the motor, and by varying the load on the dynamo, that of the motor was changed also. Three runs were made with potentials of 102, 90 and 80 volts, in each run varying the load from about 8 to 18 ampères. The results of this trial are given in Table II.

TABLE II.

No.	Speed, rev. per m.	Volts.	F'ld c'r't ampères.	Arm. c'r't ampères.	Watts consumed.
1	1680	102	9.9	9.1	928
2	1720	102	9.9	10.9	1112
3	1600	102	10	13.2	1346
4	1600	102	10	15.2	1550
5	1620	100.5	10	17.6	1795
6	1480	90	9.95	8.5	765
7	1500	91	10	7.7	701
8	1480	90	10	11.6	1044
9	1520	90	10	14	1260
10	1480	90	10	15.5	1395
11	1480	90	10	16.9	1521
12	1480	90	10	17.9	1611
13	1480	90	10	17.6	1584
14	1400	90	10	19.3	1737
15	1320	80	10	8.5	680
16	1280	79	10.5	9.8	784
17	1290	80	10.1	11.9	952

We see from this table that the speed remained practically constant, especially in the second and longest run at 90 volts potential. However, as the above conditions would never be met in practice, a final test was made in which the field current was determined by the potential at the terminals of the machine as in any shunt motor. In this case the field coil and some extra resistance constituted a shunt across the brushes. In any one run, using a constant potential at the terminals of the motor, the field current was necessarily very nearly constant or should be.

Runs were made using potentials of 110, 100, 90, 80, 70 and 60 volts, also varying the load from 3 to 25 ampères approximately. Table III. shows the results of this experiment.

TABLE III.

No.	Speed rev. per M.	Field current amp.	Armature. Volts.	Armature. Amp.	Watts consumed.
1	1800	9.9	110.2	3.2	353
2	1722	10	109.7	7.1	779
3	1750	9 95	110	11.4	1254
4	1650	10.1	110.5	15.2	1680
5	1580	10.15	110 8	20.6	2282
6	1610	10.3	109.9	23.9	2627
7	1650	9.2	99 3	3.1	308
8	1660	9.1	99.4	9	895
9	1570	9 1	100.3	13.1	1314
10	1500	9.23	100	16.6	1690
11	1440	9.4	99.9	20 8	2078
12	1620	8.1	89.7	3	269
13	1550	8 45	90.3	6.8	614
14	1400	8.5	90.5	11.9	1077
15	1390	8 6	90	16.9	1521
16	1400	8.8	90.6	21.6	1957
17	1520	7.35	80.1	3 1	248
18	1400	7.5	80.3	6.4	514
19	1340	7.55	80.2	11	902
20	1376	7.55	79.9	14.9	1191
21	1240	7.55	80.2	20.2	1620
22	1380	6.45	69.6	2.8	195
23	1230	6.7	70	7.2	504
24	1240	6.9	69.4	11	763
25	1200	7.1	69.8	15.6	1089
26	1200	7	69.8	14.7	1026
27	1120	7.1	69.2	20.2	1398
28	1240	5.7	60	3.1	186
29	1200	5.8	60.5	7.6	460
30	1100	6	59.4	11.8	701
31	1100	6	60.3	16	965
32	1000	6	60.5	20.2	1222

From the above results it is seen that for any particular run, with a certain potential, the speed remained quite constant, but that when the potential was raised or lowered the speed increased or diminished. This action is due to the curving of the internal characteristic. As the potential falls and consequently the exciting current, the magnetization does not correspondingly diminish, and hence the motor does not need to speed up to produce the requisite counter electromotive force. This results in a dropping of speed which might be interpreted as poor regulation. It is evident that in order to produce the desired result the internal characteristic must be made straighter, and this can be done by introducing a proper air gap into the magnetic circuit.

The compensating coils, so far as balancing the armature reactions and maintaining the neutral axis in the axis of commutation, performed their functions most admirably, as no sparking was observed at the brushes under the heaviest loads, and no shifting of the same was necessary.

These latter results, concerning the maintenance of the neutral axis in that of commutation of armature reactions, verify the experiments made by Dunbar and Lunt, and which were incorporated in their thesis of June, 1892.

Chronological History of Electricity—Part II.—1800-1820.

BY P. F. MOTTELAY.

RESNEL (Augustin Jean), one of the most distinguished French mathematicians and natural philosophers, communicates a paper detailing his experiments for the purpose of decomposing water by means of a magnet. He produces a current in an electro-magnetic helix inclosing a bar-magnet covered with silk and on plunging the ends of the wire in water he observed some very remarkable effects which are set forth in the *Annales de Chimie et de Phys.*, series ii., vol. xv., p. 219.[1]

A. D. 1820.——Sir Richard Phillips communicates July 11 to the *Philosophical Magazine* (vol. lvi., pp. 195-200) a very interesting paper, entitled "Electricity and Galvanism Explained on the Mechanical Theory of Matter and Motion." After reviewing the then existing theories, he concludes by saying:

> Electricity is no exception to the mechanical principles of matter and motion, and in regard to the kindred phenomena of galvanism, I will content myself with observing that it is merely *accelerated electricity*, the interposing fluid being palpably decomposed and evolving the electrical powers, each term in the series of plates being a new impulse or power added to the previous one, till the ultimate effect is accelerated, like that of a body falling by the continuous impulses of the earth's motions, or like a nail heated red-hot by accelerations of atomic motion, produced by repeated percussions of a hammer.

Consult "Bibl. Ital.," vol. xxvii., page 107, for references to his Annals of Philosophy, in which he mentions an experiment upon a young poplar, "whereby it would seem that copper was imbibed in the branches, etc., from a solution placed at its roots, and that it was precipitated on a knife used to cut off a branch."

A. D. 1820.—Brewster (Sir David), a very distinguished English natural philosopher and writer, who had just founded the "Edinburgh Philosophical Journal" in conjunction with Prof. Robert Jameson, announces his discovery of the existence of two poles of greatest cold on opposite sides of the northern pole of the earth. By this he was, like other authors, led to the belief that there might be some connection between the magnetic poles and those of maximum cold, and he remarks:[2] "Imperfect as the analogy is between the isothermal and magnetic centres, it is yet too important to be passed over without notice. Their local coincidence is sufficiently remarkable, and it would be to overstep the limits of philosophical caution to maintain that they have no other connection but that of accidental locality; and if we had as many measures of the mean temperature as we have of the variation of the needle, we might determine whether the isothermal poles were fixed or movable." Similar opinions entertained by Dr. Dalton, Dr. Traill and Mr. Christie are also mentioned by Noad, who quotes from Oersted's treatise on "Thermo-Electricity" the statement of the Danish philosopher "that the most efficacious excitation of electricity upon the earth appears to be produced by the sun, causing daily evaporation, deoxidation and heat, all of which excite electrical currents."

From his able paper in the *Edinburgh Philosophical Transactions* for 1820, an extract from which appears in the article on "Magnetism" above alluded to, one is led to share Sir David Brewster's belief "that two meridians of greatest heat and two of greatest cold are called into play, and that the magnetism of our globe depends in great measure upon electro or rather thermo-magnetic currents." The electromagnetic hypothesis was, he says, ably supported by Prof. Barlow in his paper "On the probable electric origin of all the phenomena of terrestrial magnetism," communicated to the *Phil. Trans.* for 1831. Brewster thus locates the two poles of maximum cold: The American pole in N. Lat. 73, and W. Long. 100 from Greenwich, a little to the east of Cape Walker; the Asiatic pole in N. Lat. 73 and E. Long. 80, between Siberia and Cape Matzol, on the Gulf of Oby. Hence the two warm meridians will be in W. Long. 10 and E. Long. 170, and the two cold meridians in W. Long. 100 and E. Long. 80.

As has already been indicated (under A. D. 1717, Lemery), Sir David Brewster was the discoverer of the pyro-electrical condition of the diamond, the garnet, the amethyst, etc. His development of some of Hauy's experiments led to a similar discovery, attaching to several mineral salts as well as to the plates and powders of the tourmaline, of the scolezite and the melozite; and he likewise experimented with the boracite, mesotype and with the several minerals and artificial crystals detailed at pp. 208-215, vol. i., of the *Edinb. Jour. of Sci.*, London, 1826; and in chap. ii., sec. i., vol. viii., of the Eighth "Encyc. Brit.," article on "Electricity."

At part 1, chap. 1, sec. vi., of the last named article will be found Brewster's observations on the nature and origin of electrical light, his latest researches having been made, like those of Joseph von Frauenhofer (see A. D. 1814-1815), on the dark and on the luminous lines which appear in the spectrum formed from it by a prism.

During the year 1831 appeared Brewster's "Treatise on Optics," his "Life of Sir Isaac Newton" and his "Letters on Natural Magic." It is in one of the chapters of the last named work that he treats of automatic talking machines and remarks, 'We have no doubt that before another century is completed a talking and a singing machine will be numbered among the conquests of science."

Brewster's other scientific treatises are too numerous and cover too wide a range to be enumerated here. The "Catal. of Sci. Papers of the Roy. Soc." (vol. i., pp. 612-623), gives the titles of as many as 299 contributions made by him on important subjects, and he has had no less than 76 papers in the first 39 parts of the *North British Review*, 30 in the *Phil. Trans.* and 28 in the *Edinb. Review*. They appear, in fact, in all the prominent pubications of his time, and have won for him leading honors, more especially from the Edinburgh and Aberdeen universities and the Scotch, Irish, English and French societies, the French Academy of Sciences doing him the signal honor of selecting him as one of its eight foreign associates in place of Berzelius, deceased. Conjointly with Davy, Herschel and Babbage, he originated the British Association during 1831, and it was in this same year that he was knighted and decorated by King William IV. He had been made a Fellow of the Royal Society of Edinburgh in 1808, and had during the same year undertaken the editorship of the "Edinburgh Encyclopædia of Sci., Lit. and Art." This he continued for 22 years, after which he edited the *Edinb. Jour. of Sci.*, and also entered with Taylor and Phillips upon the editorship of the *London and Edinb. Phil. Mag. and Journal.* Many of our readers will doubtless be glad to know that the last-named was a continuation of the well-known *Philosophical Magazine* so often quoted in this "Chronological History."[3]

A. D. 1820.——Fisher (George), who two years before had joined Captain David Buchan in his voyage to the Arctic regions, is the first to point out the true cause of the sudden alteration in the rates of chronometers at sea. "He observed," says Dr. Roget, "that the chronometers on board the Dorothea and Trent had a different rate of going from that they had on shore, even when these vessels had been frozen in, and therefore when their motion could not have contributed to that variation; . . . this effect could be attributed only to the magnetic action exerted by the iron in the ships upon the inner rim of the balance of the chronometers, which is made of steel. A similar influence was perceptible on placing magnets in the neighborhood of the chronometers. This conclusion was confirmed by experiments made for this purpose by Mr. Barlow, who ascertained that masses of iron devoid of all permanent magnetism occasioned an alteration in the rates of chronometers placed in different positions in their vicinity."[4]

Mr. George Thomas Fischer (1822-1847) is the author of "A Practical Treatise on Medical Electricity."[5]

A. D. 1820.——Bonnycastle (Charles), professor of mathematics in the University of Virginia, treats of the distribution of the magnetic fluids in masses of iron, and of the deviations which they produce in compasses placed within their influence, at pp. 446-456, vol. lv., of Tilloch's *Philosophical Magazine.*

He refers to the then recent publication of Mr. Barlow's "Essay on Magnetic Attractions," containing the results of many experiments, made principally upon spheres of iron, as well as to Dr. Young's views of the subject which were printed by order of the Board of Longitude, and he says that the principle upon which he intends establishing his inquiry, "is an extension of the law that regulates the action of electrified bodies upon conductors; which was first given by Mr. Poisson in the Memoirs of the Institute for 1811, and employed by him to determine the development of the electric fluids in spheres that mutually act on each other. . . ." The aforenamed dissertation calls forth a rejoinder from a correspondent and a further communication from Mr. Bonnycastle, both of which appear at pages 346-350, vol. lvi., of the same publication.[6]

A. D. 1820.——Harris (Wm. Snow), member of the College of Surgeons, and a very distinguished English scientist (1791-1867), proposes to the Board of the Admiralty his system of lightning conductors, of which an account appears at page 231, vol. lx., of the *Phil. Mag.*, and in a separate work published at London during 1822. This is followed by his "Observations on the Effects of Lightning . . .," 1823, and by papers relative to the defense of ships and buildings from lightning, published, more particularly, in several numbers of the *Nautical Magazine*, the *Phil. Mag.*, the *Annals of Electricity*, and in the *Proc. Lond. Elec. Soc.* for 1842, as well as in his Record of Phil. Papers, and under separate heads during many years between 1827 and 1854. One of his biographers remarks:

> His researches have gone far to remove certain popular errors as to what have been called "conductors" and "non-conductors" of electricity, and to show the inutility of the old form of lightning rod in the majority of cases; it being necessary, in place of such mere form, to link into one great chain all the metallic bodies employed in the construction of a building, providing, in connection with these conductors between the highest parts and the ground, the single conductor, in one highest part, being possibly insufficient to divert the course of the fluid and protect the whole fabric. These general principles have been largely applied to the protection of the ships of the Royal Navy during the last five and twenty years, under his advice and direction; and, laying aside the opinions which had been commonly received, the masts themselves of a ship have all been rendered perfectly conducting by incorporating with the spars capacious plates of copper, whilst all the large metallic masses in the hull have been tied, as it were, into a general conducting chain, communicating with the great conducting channels in the masts, and with the sea. This may be considered as the greatest experiment ever made by any country in the employment of metallic conductors for ships, and the result has been to secure the navy from a destructive agent, and to throw new light upon an interesting department of science.[7]

Harris was the first, says Brewster, who introduced accurate quantitative measures into the investigation of the laws of statical electricity—the unit measure by which quantity is minutely estimated—and the hydro-electrometer and scale-beam balance by which its intensity and the laws of attractive forces at all distances are demonstrated. Of not less value is the thermo-electrometer, by which the heating effects of given quantities of electricity are measured and rendered comparable with the varying conditions of quantity and intensity. Besides these instruments, we owe to the same philosopher the discovery of a new reactive force, by which repulsion and other small physical forces are investigated and determined by means of his bifilar balance, founded upon the reactive force of two vertically suspended parallel threads when twined upon each other at a given angle, and acted upon by a suspended weight. With the aid of these ingenious instruments he has carried on a variety of successful inquiries into the laws of electrical forces, and the laws and operations of electrical accumulation (Eighth Brit., vol. viii., p. 535). His papers on the subject appeared in 1825 and 1828, and a *résumé* of them is latter given by Noad ("Manual," 1859, pp. 35, 137-140), as well as in the Electricity article of the "Britannica," both of which contain descriptions and illustrations of Harris' unit jar and electro-thermometer.[8]

During the year 1827 Mr. Harris published in the *Trans. Roy. Soc. of Edinburgh* his memoir entitled "Experimental Inquiries Concerning the Laws of Magnetic Forces," which latter were made by means of a new and very accurate apparatus invented by him for examining the phenomena of induced magnetism. The above was followed by two other memoirs, published in the *Phil. Trans.* for 1831, "On the Influence of Screens in Arresting the Progress of Magnetic Action . . ." and "On the Power of Masses of Iron to Control the Attractive Force of a Magnet," which are discoursed of in the "Britannica" article on "Magnetism," wherein special treatment is also given more particularly to Mr. Harris' researches concerning artificial magnets as well as the magnetic charge, the development of magnetism by rotation and the phenomena of periodical variations.[9]

Besides additional apparatus named in the subjoined references Mr. Harris invented a very effective steering compass, of which an account is given in part iii., pp. 148-153, of his "Rudimentary Magnetism," as well as at p. 594 of Noad's "Manual," at p. 105 of the "English Encyclopædia" (Arts and Sciences), vol. iii., and at p. 80, vol. viii., 1875, "Encycl. Britannica," and he has also devised a magnetometer for the measurement of electric forces, of which the description and illustrations appear in the last named publication as transcribed from Mr. Harris' work already mentioned.

Mr. Harris was made a F. R. S. in 1831, and received the Copley medal four years later. It was in 1843 he published his well known work "On the Nature of Thunderstorms," the plans he advocated being adopted in 1847, when he received the order of knighthood as well as a large money grant from the English government in acknowledgment of his scientific services. The following appears in the obituary notice of Sir Wm. Snow Harris, contributed by Mr. Charles Tomlinson to the *Proceedings of the Roy. Soc.* (xvi., 1868):

> Harris' sympathies were with the Bennetts, the Cavendishes, the Singers, the Voltas of a past age. Frictional electricity was his *forte* and the source of his triumphs. He was bewildered and dazzled by the electrical development of the present day, and almost shut his eyes to it. He was attached too closely and exclusively to the old school of science to recognize the broad and sweeping advance of the new. He was not conscious even of being behind his age when he presented to the Royal Society in 1861 an elaborate paper on an improved form of Bennett's discharger, and still less in 1864, when he discussed the laws of electrical distribution, and still relied upon the Leyden jar and the unit jar.[11]

---

[1] See "Eloge de Fresnel," by Arago in his "Œuvres," vol. i.; account of Fresnel's life in the "Biog. Univ.;" Whewell, "Hist. of Induc. Sci.," 1859, vol. ii., pp. 96, 102, 114-117.

[2] Noad "Manual," London, 1859, p. 545, and article "Magnetism" in Encyl. Brit.

[3] See the obituary notice contributed by Dr. J. H. Gladstone to the proceedings of the Royal Society; *Chemical News*, Amer. reprint, vol. ii., pp. 198, 233; also page 293 for accounts given by Sir J. Simpson and Prof. Fraser; J. Robison and Brewster, "A System of Mechan. Phil.," London and Edinb., 1822; Ferguson and Brewster's "Essays and Treatises on Astr. Elect., etc.," Edinburgh, 1823; Brewster's several articles in the Encyl. Britannica, 7th and 8th editions, on Electricity and Magnetism: *Transactions of the Roy. Soc. of Edinburgh*, vols. ix., 1821, xx., part iv.; *Edinb. Jour. of Sci.*, Oct., 1824, No. ii., p. 213; Noad, "Manual," London, 1859, pp. 31, 32, 636-638; Harris' "Magnetism," part iii., p. 119; Whewell, "Hist. of Induc. Sci.," 1859, vol. ii., pp. 75, 81, 331, 332; the lectures delivered by Wm. A. Miller during 1867 before the Royal Institution of Great Britain.

[4] See Mr Fisher's article "On the Errors in Longitude as Determined by Chronometers at Sea, Arising from the Action of the Iron in the Ships upon the Chronometers," communicated by John Barrow, F. R. S., to the *Phil. Mag.*, vol. lvii., pp. 249-257. See, besides, *Edinburgh Jour. Sci.*, London, 1826, vol. v., p. 224; *Phil. Trans.* for 1820, part ii., p. 196, and the volume for 1833, relative to magnetical experiments; also the "Lib. U. K." (Magn.), p. 63. For Capt. Buchan consult Barrow's "Chronological History of Voyages into the Arctic Regions."

[5] Poggendorff, vol. i, p. 756.

[6] Consult Silliman's *Journal*, vol. xl., p. 32; Sketch of the Life of Chas. Bonnycastle, by Thomas Thomson; Poggendorff, vol. i, pp. 234, 235; article "Magnetism," p. 9, vol. xiv., of the Eighth "Britannica."

[7] See Whewell, "Hist. of Induc. Sci.," vol. ii., pp. 199, 200; *Phil. Mag.* for March, 1841; Eighth "Enclyc. Britannica," vols. viii., pp. 535, 610, 611 and xx., p. 24; "Edinb. Review," for Oct., 1844, vol. lxxxi., p. 442.

[8] See *Trans. of the Plymouth Institution*, also *Trans. of the Roy. Soc.* for 1834, 1836, 1839; "Penny Encyl." (Common Electricity), vol iii., p. 801; W. A. Miller, "Elem. of Chem.," 1864, p. 32. For descriptions of his bifilar balance see the "Britannica," vol. viii., p. 623; *Phil. Trans.* for 1836; Harris, "Rud. Elec.," p. 99, and "Rud. Magn.," pp. 119, 120; Noad, "Manual," pp. 40, 41; C. Stabelin, "Die Lehre . . . ," 1852; P. Volpicelli, "Ricerché analitiche . . . ," Roma, 1865, while, for his balance electroscope and electrometers, see "Edinb. Phil. Trans.," Dec., 1831; "Britannica," vol. viii., pp. 540, 590, 620, 622, 624; Harris, "Rud. Elec.," p. 99, etc; Noad, "Manual," pp. 26, 27, 35, 37, 63, 580; the "Bakerian Lecture"; the *Phil. Trans.* for 1834 and 1839, as well as the "Report of British Association," Dundee, 1867, for an able account of electrometers by Sir William Thomson. His electrical machine is described at pp. 74-76 of Noad's "Manual," as well as at p. 604, vol. viii., of the "Britannica," the latter also giving, at p. 550, Harris' experiments on the electrical attraction of spheres and planes.

[9] "Rudim. Mag.," part iii., p. 60.

[10] See Fahie's "Hist. of Elec. Tel.," pp. 283, 284.

[11] See "Catal. Sc. Papers Roy. Soc.," vol. iii., pp. 191-193; Lippincott's "Biog. Dict.," 1886, p. 1,230; Biography in Harris' "Frictional Electricity"; "Abstracts of Papers . . . Phil. Trans., 1800 to 1830," vol. ii., p. 293; *Lumière Electrique* for Oct. 3, 1891, p. 49; reprint of Sir Wm. Thomson's Mathematical Papers, 1872; "Brit. Asso. Reports" for 1832, 1835, 1836; *Edinb. Phil Trans.* for 1834; Fahie's "History," p. 321; *Edinb. and London Phil Mag* for 1840; *Phil. Trans.*, 1842; *Phil. Mag.* for 1856-1857, and Harris' Manuals of Electricity, Galvanism and Magnetism, published in Weale's Rudimentary Series.

Experimental Determination of Electrical Oscillations.

M. P. Janet, in a recent number of the *Comptes Rendus*, describes an investigation of the electrical oscillations occurring in conductors when their circuit is subjected to some sudden change. The experimental results which he obtained may be of special interest in connection with the theoretical deductions made recently by Messrs. Bedell and Crehore, of the Cornell University.

The arrangement of the apparatus which was used is shown in Fig. 1. A battery *P* was joined up in circuit

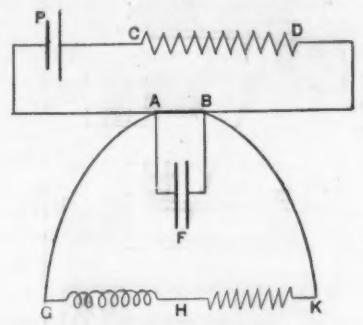


FIG. 1.—ELECTRICAL OSCILLATIONS.

with a high resistance, *C D*, of about 20,000 ohms, and also with a short-circuiting connector, *A B*. The points *A B* were connected with the terminals of a condenser *F*, of about one-tenth of a microfarad, and also with a solenoid *G H* and a non-inductive resistance *H K* in series. The resistance of the solenoid was 228 ohms and its self-induction 0.6 henry. The resistance of *H K* was 272 ohms.

On the removal of the short-circuit piece *A B*, electric oscillations are set up in the circuits which were investigated by M. Janet with the aid of a special contact maker, which is operated at a regular speed by a water motor, and makes two contacts periodically at a certain interval of time from each other, the amount of which can be adjusted at will. The first contact was arranged to remove the con-

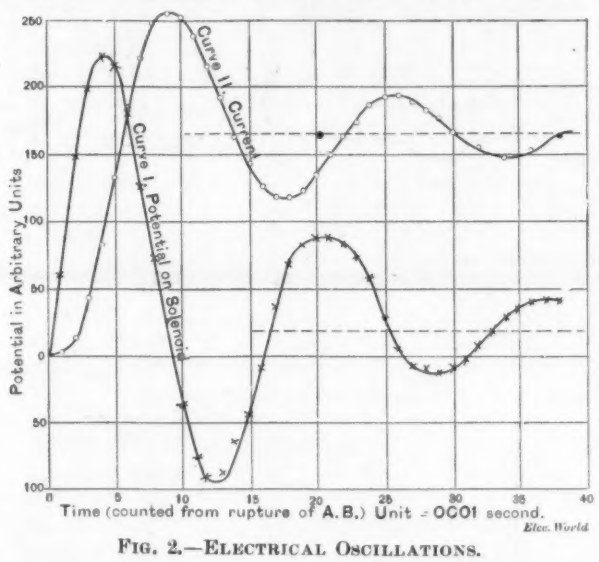


FIG. 2.—ELECTRICAL OSCILLATIONS.

nector *A B*, and the second to connect the terminals of a condenser to two points of the circuit whose potential was under investigation. The charge of this condenser, measured subsequently in the usual way with a ballistic galvanometer, indicated the instantaneous value of the voltage existing between the points to which the condenser had been momentarily connected. The interval between the two contacts was varied in different experiments from 0.0001 second to 0.0038 second. The measured potentials between the point *G H* and *H K* are plotted as ordinates in the curves, Fig. 2, the abscissæ denoting the time interval after the rupture of the short circuit at *A B*. As the resistance *H K* was non-inductive, the voltage between these points represents the current flowing in the conductor *G H K*. This current is shown in Curve II., the voltage on the solenoid being denoted by Curve I. The dotted lines represent the steady value attained by the potentials after the electrical oscillations have subsided. The oscillations die out after about 0.004 second, as shown by the curves.

The Large Search Light for the World's Fair.

Some time ago a large search light made by the firm of Schuckert & Co., of Germany, was brought to this country for exhibition at the World's Fair. It will be placed on the tower of the Transportation Building, and is intended for the illumination of Jackson Park and the neighboring territory. The following data regarding this search light may be of interest:

The reflector is four feet in diameter. The candle power of the arc light alone, without lens or reflector, is 150,000 candles. This, we presume, refers to the light measured in the direction in which it has its maximum, for, as is well known, the carbons in search lights do not run in line with each other, but are displaced so as to throw the light from the crater in one direction only. With the aid of the parabolic reflector and the lens the candle power is increased to 460,000,000 candles. The carbons are 12 inches long and about $1\frac{5}{16}$ inches in diameter. In addition to the usual movements, it can be projected upward in a vertical direction. The test is said to have been very satisfactory.

Electricity at the World's Fair.

(From Our Special Correspondent.)

LIGHTING OF THE ADMINISTRATION BUILDING.

Among the many stately buildings that have been designed and built for the World's Exposition there is none that ranks so high in point of architectural beauty and artistic embellishment as the Administration Building. The symmetry of its outlines is apparent at a distance, but it is only when one enters and stands beneath the vault of the great dome with its richly sculptured friezes and brilliant frescoing that the value of intelligent treatment in the matter of illumination is appreciated. The building has been so often and so well described in the newspapers and magazines that its style of architecture is presumably familiar to all the readers of THE ELECTRICAL WORLD, and it is therefore only such points as are affected by and relate to the electric lighting that will be considered in this article. A very brief description will therefore suffice.

The building consists of a central portion, octagonal in form, flanked by four pavilions, which are four stories in height. These pavilions will contain the offices of the Council of Administration, chiefs of departments, representatives of the press, a post-office, telegraph offices, a bank, etc. Access is had to the various floors by means of electric elevators, two in each pavilion. Above the pavilions, and encircling the central portion, is a colonnade, and above this is a gallery also encircling the central portion. Above this gallery spring the arches which form the dome.

The building is wired for 4,754 lights, of which number 1,752 are used for decorative purposes on the exterior. These are distributed upon the cornices, ribs of dome and corona. In the interior 792 lights are used for lighting the rotunda and dome, the remaining 2,210 being in offices, loggias and entrances.

The primary wires for supplying the current for the lights in this building are brought from the generating plant in Machinery Hall, 700 feet to the south, through the main subway, to a point opposite the east entrance. From this point to the converter pits the wires are drawn into pumplog ducts. The converter pits, eight in number, are located one at each side of the four main entrances in the angles of the building. They are about five feet long, four feet wide and five feet deep, and are buried in the ground to a depth of four feet. The cover is so arranged that a thorough circulation of air takes place at all times, but no rain can beat in. The converters are mounted upon insulating feet to insure them against any possibility of grounding.

From the converters the secondary feeders are carried through ducts of vitrified sewer pipe to the main cut-out boxes located in closets under the stairs. From the main cut-out boxes the feeders rise within the hollow walls to cut-out boxes on the different floors. These boxes are located in closets opening from the stair landings. The cut-out boxes are built of wood and lined with asbestos, and are fitted with doors provided with locks.

As far as possible the wiring is done in interior conduit. Where this could not be done, a neat molding is used, dead molding being run where necessary to give a uniform and symmetrical appearance. The building is wired for a potential of 100 volts, the primary E. M. F. at the converters being 2,000 volts.

Each of the four main entrances is lighted by two 25-light brackets of unique design. The main floor of the rotunda has eight 50-light standards, one in each angle of the wall. These standards are about fourteen feet in height and are very beautiful in design, the lamps, with their opalescent shades, giving the effect of great clusters of lilies.

At a height of 82 feet from the floor the rotunda is encircled by a gallery, upon the rail of which are mounted fifty-six standards bearing seven lights each, and of a design similar to that of the 50-light standards on the main floor, the arms carrying the lamps branching from the central stem somewhat like the sticks of a fan. The lamps and shades are arranged to throw the light upward and toward the centre, thereby effectively lighting the beautiful frescoing in the arch of the dome. Within the dome proper, and about twenty-five feet below it, is built a false dome, a method of construction adopted by architects to preserve the correct proportions of the building when viewed from the interior.

This false dome has a circular opening at its apex, 47 feet in diameter. Between the false dome and the dome proper are placed eight 2,000-c. p. arc lamps. These are placed out of the line of vision, their office being to produce an intense glow in the space above the false dome without the source of light being visible.

Nearly all the standards and fixtures used in the building are of special design and are finished in oxidized copper to harmonize with the old oak of the doors and wainscoting. In loggias and lobbies individual opalescent shades are used, and in the offices the whole cluster (mostly six lights) are shaded by large opalescent umbrella shades.

Turning again to the exterior of the building we find lights used for decorative effects in surprising profusion. On the cornice which surrounds the building at the roof level of the pavilions are placed 800 lights at intervals of two feet.

The cornice above the colonnade story is also outlined with lights, 390 being used, the distance apart being the same as on the cornice below.

The colonnades are lighted by lamps placed on the backs of the columns. They are arranged in vertical rows, four to each column, the object being to produce a bright glow behind the columns, making the latter stand out in sharp silhouette against the bright background, while the source of light is not visible from below.

Upon the gallery above the colonnade we find the only place where gas is used as an illuminant in any of the exposition buildings, and even here it is used not so much for illumination as to produce striking artistic effects. Arranged around the gallery are 32 large candelabra, 16 feet in height. These are connected with the gas supply system and when in operation the flames shoot high into the air, making fantastic shadows dance upon the walls as the flames are blown by the wind.

The dome on this building is octagonal in form, the angles being marked by large ribs. The spaces between the ribs are large panels ornamented with scroll work in relief. The ribs are outlined by 320 lamps, 40 to each. They are spaced two feet apart, the same as on the cornices. The matter of accessibility is one which has of necessity been carefully considered, as not only must the work be done in the first place, but some means must be provided for replacing burned out lamps, and also that all parts may be open to inspection at any time. To meet these requirements iron steps have been provided forming a ladder on each rib, and a door is cut in the dome just under the corona to give access thereto. For these, and also for the cornice lights, a special form of socket is used, it being similar to a wall receptacle standing upon feet. The wire requires no supports nor insulators other than those provided by the sockets themselves.

Upon the corona which surmounts the dome are placed eighty lights. This corona is built of galvanized iron and in the figures of the scroll work the lamps are placed.

It is expected that the effect of this building when lighted will be the finest ever produced, and certainly the amount of time and study (to say nothing of the money) which has been expended upon it to produce beautified lighting effects should be a guaranty that these expectations will be fully realized.

Owing to the delay in getting the generating plant in Machinery Hall into working order, none of the lights in the building are in operation except those used in the offices of the Council of Administration and a few others. These lights are now run from the temporary plant.

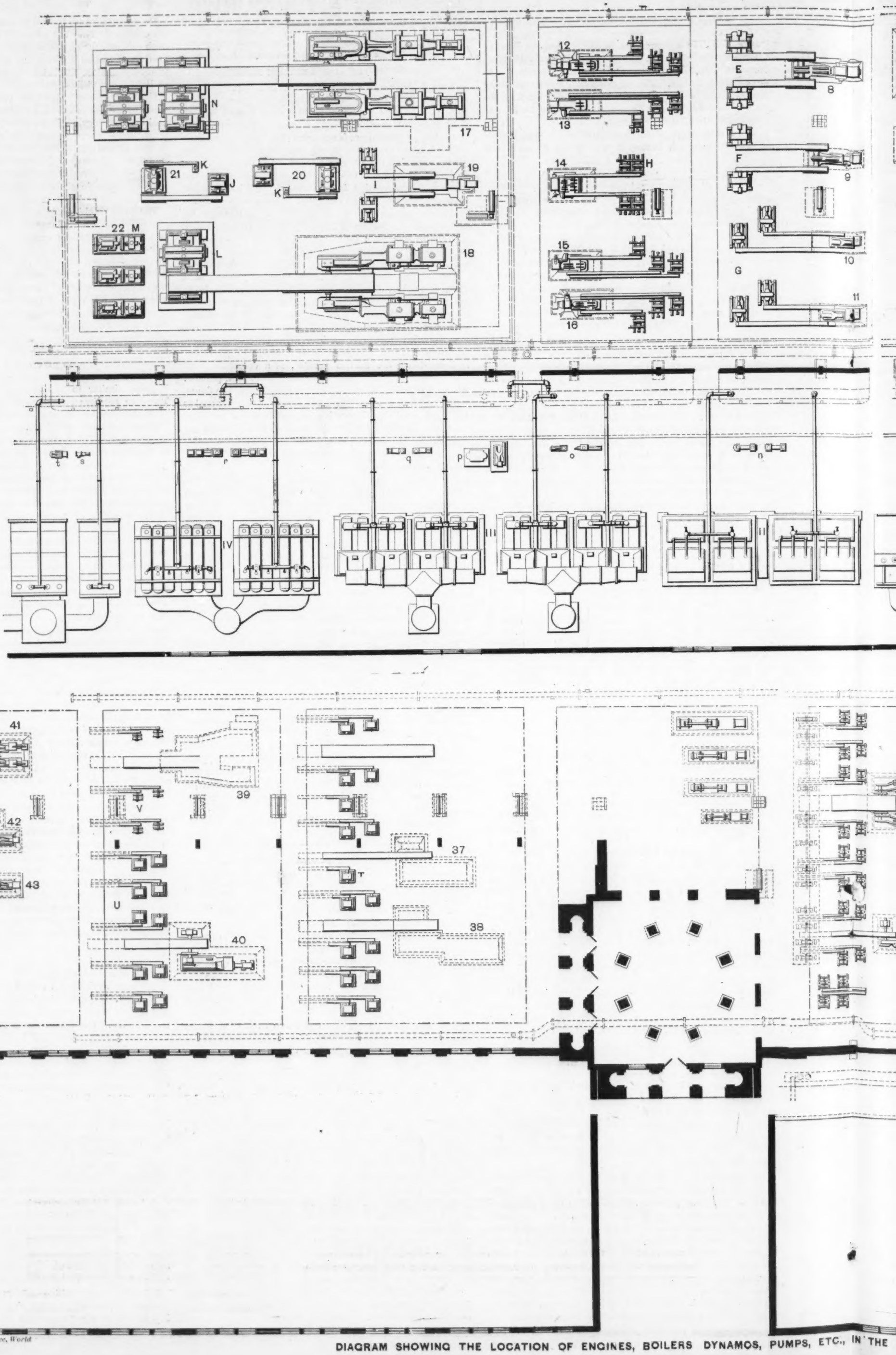
Notwithstanding the fact that this building will be used only for six months, the work of wiring has been done as thoroughly and carefully as if it was to stand for all time. The rules of the National Board have been strictly adhered to and all work carefully inspected.

The French Exhibit Not Affected by the Troubles in France.—In view of the marked feeling of unrest, to express it mildly, which now pervades the French Republic, much speculation has been rife as to its probable effect upon the part which France will take in the coming World's Fair. It will be remembered that France has been allotted by far the largest space in the Electricity Building of any of the foreign countries, and the display from that country has been counted upon as one of the most important. To lose this through any cause would be a misfortune to the exposition. It seems that the World's Fair authorities are not disturbed at all. The new French Commissioner, who now holds the reins, is not in politics, and cannot, therefore, be in any way involved in the Panama scandals; the French exhibits are so far advanced that it is believed that no troubles of state can prevent their completion; and finally, the three vessels which are to transport these exhibits to this country have been chartered and the days for sailing set, so that it is believed that even the overthrow of the Republic would not prevent the display as originally contemplated.

Arrangements for the Comfort of Visitors.—The comfort of visitors will be well provided for. The two restaurants in the bays at the north end of the building, overlooking the lagoon and the wooded island, will provide a convenient resting place for the weary, and ample accommodation for the hungry. The prices to be charged for refreshments will be carefully scrutinized by the exposition authorities and no impositions whatever allowed. In fact, all the arrangements within the building are admirable. The management seem to have thought of everything and to have provided for everything, and it seems probable that not the least of the glories of the exposition will be the perfect provision against all contingencies of a disagreeable nature which have so often marred the pleasure of a visit to previous exhibitions.

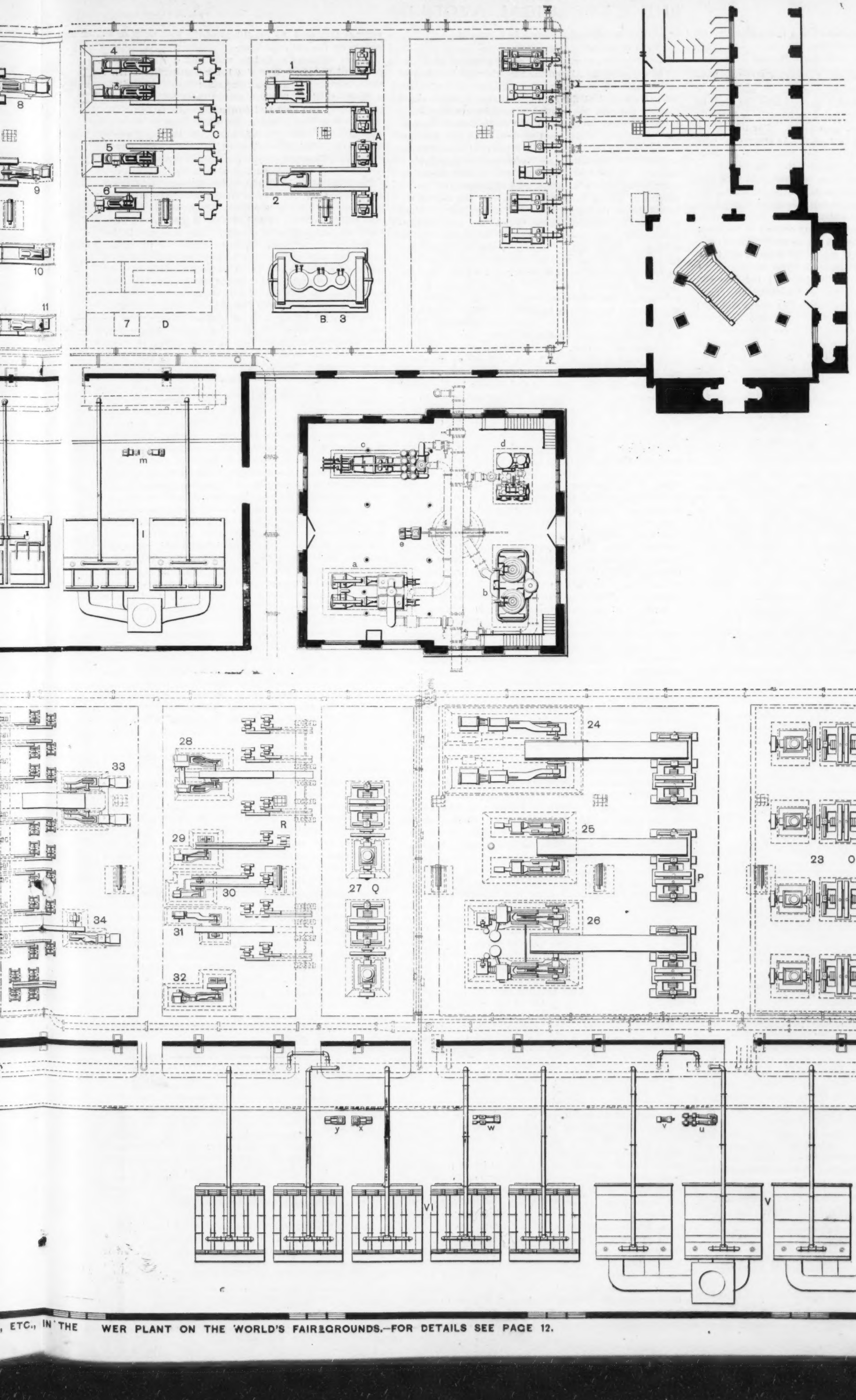
The capabilities of the grounds and buildings to accommodate large numbers were strikingly illustrated at the dedication ceremonies. It was estimated that there were at that time not less than than 100,000 people in the Liberal Arts and Manufactures Building, and that there were at one time on the grounds not less than twice that number, yet there was at no time or place the appearance of a crowd. If this were true when but a single building was open, one can form an estimate of the masses that can be comfortably accommodated when the attractions are distributed throughout the whole area of the park.

Drinking water will be provided free from numerous faucets conveniently located throughout the building and Hygeia water, piped especially for the occasion from the



Elec. World

DIAGRAM SHOWING THE LOCATION OF ENGINES, BOILERS DYNAMOS, PUMPS, ETC., IN THE



, ETC., IN THE WER PLANT ON THE WORLD'S FAIR GROUNDS.—FOR DETAILS SEE PAGE 12.

springs at Waukesha, will be sold at a cent a glass to those who prefer this to the lake water.

All of the buildings at the Exposition Grounds have large amounts of glass in their roofs for the admission of light. Were not these shaded in some way the glare on bright days would be very trying to the eyes and greatly detract from the effect of the exhibits. For this reason all of these skylights will be shaded. At present the sewing machines are all worked by foot power, and the work is consequently slow, but next week they will be operated by an electric motor, and it is believed that with this assistance 20,000 yards a day can be finished. The amount of work to be done in this line can be appreciated when it is known that the Manufactures Building alone will require 148,000 yards and that several of the other buildings will require from 55,000 to 85,000 yards each. This skylight drapery will consist of two-colored bunting, so combined as to produce an effect helpful to the exhibits. For instance the Agricultural Building will have two shades of green, Nile and deep-sea green; the Electricity Building will be decorated in cream and light blue; the Manufactures Building, white and corn; the Mining Building, cream and shrimp; the Transportation and Machinery halls, light cream; and the Horticultural a light shade of apple-green. It is estimated that 1,000,000 yards of bunting will be used for these and other interior decorations.

On the preceding page is shown the plan of the World's Fair power plant, which was described in THE ELECTRICAL WORLD of Dec. 10, 1892. The following list shows the locations of the various types of engines, dynamos, etc.

ENGINES IN POWER PLANT.

1. Ball cross comp., 480 h. p.
2. Armington and Sims simple, 400 h. p.
3. General Elec. trip. exp. cond., 1,000 h. p.
4. Phœnix trip. exp. cond., 500 h. p.
5. Phœnix tan. comp. cond., 250 h. p.
6. Phœnix simple, 250 h. p.
7. E. P. Atlas cross comp. cond., 500 h. p.
8. Woodbury tand. comp. cond., 600 h. p.
9. Woodbury tand. comp. cond., 375 h. p.
10. A. L. Ide simple, 200 h. p.
11. A. L. Ide tand. comp. cond., 225 h. p.
12. Ball and Wood cross comp., 260 h. p.
13. Ball and Wood simple, 150 h. p.
14. Ball & Wood tand. comp., 150 h. p.
15. Ball & Wood simple, 150 h. p.
16. Ball & Wood tand. comp., 160 h. p.
17. E. P. Atlas quad. exp. cond., 150 h. p.
18. Fraser & Chalmers, trip. exp. comp., 2,000 h. p.
19. McEwen tand. comp. cond., 220 h. p.
20. Westinghouse, Church, Kerr comp. cond., 330 h. p.
21. Westinghouse, Church, Kerr comp. cond., 330 h. p.
22-3. Westinghouse, Church, Kerr comp. cond.
23-4. Westinghouse, Church, Kerr comp. cond., 1,000 h. p.
24. Buckeye trip. exp. comp., 1,000 h. p.
25. Atlas com. cond., 1,000 h. p.
26. McIntosh & Seymour doub. tan. com., 1,000 h. p.
27. Westingh., Church, Kerr com. con., 1,000 h. p.
28. Buckeye cross comp. cond., 300 h. p.
29. Buckeye simple, 125 h. p.
30. Buckeye simple, 125 h. p.
31. Buckeye simple, 190 h. p.
32. Buckeye tand. comp., 150 h. p.
33. Russell doub. tand. comp. cond., 506 h. p.
34. Russell doub. tand. comp. cond., 216 h. p.
36. Lane & Bodley cross com. con., 300 h. p.
37. Lane & Bodley tand. com. con., 300 h. p.
38. Lane & Bodley simple, 200 h. p.
39. Bass cross comp. cond., 224 h. p.
40. Atlas tand. comp. cond., 500 h. p.
41. Watertown doub. tand. com. con., 250 h. p.
42. Skinner simple, 150 h. p.
43. Skinner simple, 150 h. p.

DYNAMOS.

A. 4 Edison power generators, 200 h. p. each.
B. 2 Edison multipolar generators, 500 h. p. each.
C. 4 Eddy power generators, 250 h. p. each.
D. 1 Westinghouse railway generator, 500 h. p.
E. 2 Mather power generators.
F. 2 Mather power generators.
G. 4 C. & C. power generators, 100 h. p. each.
H. 16 Brush arc dynamos, 50 lights each.
I. 2 C. & C. power generators, 100 h. p. each.
J. 2 Westinghouse incandescent dynamos, 4,000 lights each.
K. 2 Westinghouse exciters.
L. 1 Westinghouse incandescent dynamo, 10,000 lights.
M. 3 Westinghouse exciters.
N. 2 Westinghouse incandescent dynamos, 10,000 h. p. each.
O. 4 Westinghouse incandescent dynamos, 10,000 h. p. each.
P. 3 Westinghouse incandescent dynamos, 10,000 lights each.
Q. 2 Westinghouse incandescent dynamos, 10,000 lights each.
R. 14 Fort Wayne arc dynamos, 50 lights each.
S. 20 Standard arc dynamos, 50 lights each.
T. 16 Thomson-Houston arc dynamos, 50 lights each.
U. 10 Thomson-Houston arc dynamos, 50 lights each.
V. 6 Excelsior arc dynamos, 50 lights each.
W. 10 Western electric arc dynamos.

BOILERS IN POWER PLANT.

I. Root, 2 bat., 4 boilers, 1,500 comp. h. p.
II. Gill, 2 bat., 4 boilers, 1,500 comp. h. p.
III. Heine, 2 bat., 8 boilers, 3,750 comp. h. p.
IV. National, 2 bat., 4 boilers, 1,500 comp. h. p.
V. Campbell & Zell, 5 bat., 8 boilers, 3,750 comp. h. p.
VI. Babcock & Wilcox, 5 bat., 10 boilers, 3,000 comp. h. p.

FEED PUMPS.

m. 2 Dean, 7⅛ × 4½ × 10.
n. 2 Barr, 9 × 5¼ × 10.
o. 2 Knowles, 10 × 5 × 10.
p. 1 Goulds, 10 × 12.
q. 2 Blake, 8 × 5 × 12.
r. 2 Davidson, 12 and 20 × 10½ × 20.
s. 1 Cameron.
t. 1 Laidlaw, 7½ × 4½ × 10.
u. 1 Wilson & Snyder, 14 × 8 × 18.
v. 1 Canton.
w. 1 Snow, 8 and 12 × 7 × 12.
x. 1 Snow, 10 × 6 × 10.
y. 1 Snow, 8 × 5 × 10.

PUMPING STATION.

a. Worthington, 25 and 50 × 27½ × 36, duplex horizontal, 12½ million gallons per day.
b. Worthington, 30 and 60 × 32 × 60 duplex, vertical, 15 million gallons per day.
c. Worthington, 6 and 9½ and 15 × 9½ × 48, duplex horizontal, 5 million gallons per day.
d. Worthington, 2, 15 and 33 and 57½ × 22 × 36 vertical, 7½ million gallons per day.
e. 2 Worthington, 16 × 9¼ × 10 fire pumps.

CIRCULATING PUMPS.

f. Worthington, 18½ and 29 × 17 × 18.
g. Worthington, 16 and 25 × 15 × 15.
h. Worthington, 14 × 22 × 15.
i. Worthington, 12 × 14 × 10.
j. Worthington, 14 × 19 × 15.
k. Worthington, 29 × 20 × 18.
l. Worthington, 14 and 24½ × 20 × 18.

Electrical Progress in Germany

(From our Special Correspondent.)

The report of the Allgemeine Elektricitaets Gesellschaft on the business year ending June 30, last, reviewing the work accomplished during these twelve months, states that the company has devoted its energies almost entirely to the care and development of manufacturing, the sale and installation of the plant produced and the construction of electric tramways; while it has held aloof from all undertakings requiring the investment of considerable capital. In view of the conditions brought about by competition, which naturally find expression in the reduction of prices, the report holds that the results obtained should be regarded as satisfactory, and the more so, since the deliveries made to the Berliner Elektricitaetswerke had been exceedingly limited. The incandescent lamp factory had, nevertheless, turned out 150,000 more lamps than in the previous year. As regards the electric tramway business, the undertaking in Gera had developed so rapidly that an increase in the rolling stock had very soon been rendered necessary, and the company had already been able to deliver some additional motor cars during the present business year. Work on the Kiew road had progressed so well that the running was begun last spring. The installation of this, the first electric road in Russia, had met with strong approval; and here too the equipment had exhibited such satisfactory results that the company had already been engaged on the execution of important further orders for extensions of the line. The construction of the electric tramway in Breslau had been commenced toward the close of this last business year, and this would, when completed, be the largest electric road in Europe. The company had further the order for the electric equipment of the Chemnitz tramways. There were orders on the books of the Tramway Department for the current year representing a total value of one and a quarter million dollars, and further contracts were pending. The report then refers to the question of the application of electricity to navigation purposes, to which some attention had been given. The company has some electric launches plying on a lake near Berlin, and the experience gained points to further developments in the direction of electric navigation. The net profits on merchandise account realized $357,330, against $465,310 in the preceding year. A dividend of 7½% was declared. If the fact that the orders now on the company's books represent a total value of $2,440,476, against $1,666,666 in the preceding year, be any criterion, then the prospects of the present business year showing good results would seem fairly well assured.

The death of Dr. Leopold Loewenherz, director of the Physikalisch-technische Reichsanstalt, Berlin, which took place on the 30th of October, is to be deeply regretted. Dr. Loewenherz was born at Czarnikau in the province of Posen in 1847. He entered the university of Berlin in 1866, where he studied mathematics, physics and astronomy for about four years. After attaining the degree of doctor in 1870, he undertook the position of an assistant in mathematics and physics on the Normal Testing Commission founded in the same year, and then under the direction of Wilhelm Foerster. While engaged in this work he had ample opportunity for acquainting himself with the shortcomings under which the scientific development of technics labored in Germany. This had the effect of making him a zealous advocate for the establishment of an institution that would satisfy this want. It was in this way that the Physikalisch-technische Reichsanstalt came into existence, and was developed mainly with his active co-operation, the institution becoming, under his direction in conjunction with Prof. Helmholtz, of recognized importance abroad as well. Dr. Loewenherz's untiring efforts regarding the introduction of a standard screw-thread were of the greatest importance; unfortunately he did not live to see their completion. The conference which was to have been held in Munich to examine into the question had been postponed, owing to his illness, when his death intervened.

Some experiments have recently been made relative to the electric lighting, by means of accumulators, of the trains on the City Elevated Railway in Berlin, and they are said to have been very satisfactory. Five incandescent lamps, each of 6 c. p., suffice to light a carriage well.

The Berliner Elektricitaets-Werke have issued a circular to current consumers with reference to the new alternative tariff, which will be introduced on the 1st of January, 1893, regarding the supply and care of lamps in installations run from the company's mains, inquiring whether the consumer elects to supply and attend to the lamps himself, paying to the Elektricitaets-Werke the yearly sum of $3.50 for every arc lamp and 50 cents for every incandescent lamp; or whether the old conditions are to continue, under which the Elektricitaets-Werke provide and look after the lamps against the yearly payment by the consumer of $7 for every arc lamp and $1.15 for every incandescent lamp. The price for current furnished remains as before, 0.85 cent per lamp-hour. Knowing the price of an incandescent lamp, say 20 cents, and the average life of the same, which may be put down at 400 to 500 hours, it is easy for every consumer to determine for himself whether it will be to his advantage to accept the conditions of the new tariff or to remain by the old conditions.

Messrs. Siemens & Halske will build a large central power of the river Wesenitz being utilized for driving the dynamos. The neighboring towns and villages within a radius of about 9 miles, among them Schandau, will be supplied with light and power from this station. The same firm is also planning the construction of an electric railway from Frankfort-on-Main to the Taunus Mountains, which, if carried out, will doubtless prove a formidable rival to the existing steam railroads that intersect this picturesque part of the country.

The Allgemeine Elektricitaets Gesellschaft has secured the contract for the electric equipment of the tramway in Essen, the seat of the great Krupp industry. The road will be between 11 and 12 miles in length, and work has been begun upon it already. The line will be installed on the overhead conductor system of the Allgemeine company, namely, the Sprague system. About 20 motor cars will be put on to commence with, each of which will be capable of drawing one or two tow cars, not only on the level but also up considerable grades.

Tenders for the electric lighting of Frankfort-on-Main were received on the 27th of October. There were 40 altogether, of which 6 were for the entire installation. The result of the tenders will be made known in about a month's time from now. The offers are to hold good up to the end of December.

Practical Primary Batteries.

BY CONVERSE D. MARSH.

In a recent issue of THE ELECTRICAL WORLD Mr. George H. Lee, while being properly plain in instancing his unfortunate experiences with some forms of primary batteries, makes several unconditional assertions of extreme breadth, which a knowledge of the leading types of closed circuit batteries of the present day would not warrant.

One might presume, from Mr. Lee's energetic condemnation, that all depolarizers threw off dangerous and corrosive gases, and were worthless after having been mixed for a few days. Even a cursory glance into the field, which has been so narrowed by the experience of recent years, should give the knowledge that both nitric acid and its salts have been dropped by those who are legitimately engaged in the sale of primary batteries, building up a business on the merit of their products, and not by false and devious promises attempting for a short period to open up a large market for their wares, which must need result in their own undoing. Nitric mixtures are still used by that plausible, stock-offering gentry, who can for a few days at utmost produce by its aid, in conjunction with porous diaphragms, sellable results. The deluded amateur enthusiast, too, boldly attacks his nitrous antagonist, fascinated by the first effects, which are superior to any other chemical combination, and all unheedful of the practical points which dear experience is to teach him cannot be met by nitric acid nor by porous clay pots.

Chemicals well adapted for battery solutions, that do not fume, and which do not deteriorate with age after having been brought together, are so well known by chemists and manufacturers that their enumeration would waste space.

If Mr. Lee is sufficiently interested, I can show him small primary battery plants used in offices, while close at hand are delicate steel surgical instruments that remain unaffected. I can also show him zincs that are used many weeks without amalgamation, and cells of battery which have no wasteful local action, maintaining a constant electromotive force throughout their life.

The advance in the battery field within very recent periods has approached the progress in other lines of electricity, and this improvement must be so patent to investigators that the old fashion of decrying anything pertaining to progress in the production of electricity chemically must be put aside with other prejudices of the past, since the real and earnest workers have realized the uselessness of competing with coal, and have with success bent their attention to the many profitable branches of electrical labor to which the proper forms of primary battery are peculiarly adapted.

Hereafter, would it not be as well to let us hear more of recent successes than of past failures?

Aluminium.

"Sebrof," in a recent number of *Engineering*, states that there is ten times more aluminium in the world than there is iron, lead, copper, zinc, nickel, gold and silver combined. He furthermore states that Dr. Meyer, of Berlin, has discoved a process by which the metal can be produced at about four cents per pound; (in 1828 the price was $5,000 per pound) the price to-day is about $1 per pound.

Effect of Electric Light on Plants.

At a recent meeting of the Manchester Association of Engineers, Mr. B. H. Thwaite, referring to the effect of electric light in accelerating the action of plant life, showed the leaves of the *Acacia cophanta*, which were closed while in darkness, when removed into the brilliant beam of the arc light opened almost magically, the leaves nearest the root being the first to be influenced.

Report of the Board of Trade Committee on Electrical Standards.

Subsequently to the presentation of our former report* to Sir Michael Hicks-Beach in July, 1891, we were informed that it was probable that the German government would shortly take steps to establish legal standards for use in connection with electrical supply, and that, with a view to secure complete agreement between the proposed standards in Germany and England, the director of the Physico-Technical Imperial Institute at Berlin, Prof. Von Helmholtz, with certain of his assistants, proposed to visit England for the purpose of making exact comparisons between the units in use in the two countries, and of attending the meeting of the British Association which was to take place in August in Edinburgh. Having regard to the importance of this communication it appeared desirable that the Board of Trade should postpone the action recommended in our previous report until after Prof. Helmholtz's visit.

That visit took place early in August, and there was a very full discussion of the whole subject at the meeting of the British Association in Edinburgh, at which several of our number were present. The meeting was also attended by Dr. Guillaume, of the Bureau International des Poids et Mesures, and Prof. Carhart, of the University of Michigan, U. S. A., who were well qualified by their scientific attainments to represent the opinion of their respective countries. It appeared from the discussion that a few comparatively slight modifications of the resolutions included in our previous report would tend to secure international agreement. An extract from the report† of the Electrical Standards Committee of the British Association embodying the results of this discussion was communicated to us by the secretary, and will be found in the appendix to this report.

Having carefully reconsidered the whole question in view of this communication, and having received the report of the sub-committee mentioned in resolution 14 of our previous report, we now desire, for the resolutions contained in that report, to substitute the following:

RESOLUTIONS.

1. That it is desirable that new denominations of standards for the measurement of electricity should be made and approved by Her Majesty in Council as Board of Trade standards.

2. That the magnitudes of these standards should be determined on the electromagnetic system of measurement with reference to the centimetre as unit of length, the gramme as unit of mass, and the second as unit of time, and that by the terms centimetre and gramme are meant the standards of those denominations deposited with the Board of Trade.

3. That the standard of electrical resistance should be denominated the ohm, and should have the value 1,000,000,000 in terms of the centimetre and second.

4. That the resistance offered to an unvarying electric current by a column of mercury at the temperature of melting ice 14.4521 grammes in mass of a constant cross-sectional area, and of a length of 106.3 centimetres may be adopted as one ohm.

5. That a material standard, constructed in solid metal, should be adopted as the standard ohm, and should from time to time be verified by comparison with a column of mercury of known dimensions.

6. That for the purpose of replacing the standard, if lost, destroyed, or damaged, and for ordinary use, a limited number of copies should be constructed, which should be periodically compared with the standard ohm.

7. That resistances constructed in solid metal should be adopted as Board of Trade standards for multiples and submultiples of the ohm.

8. That the value of the standard of resistance constructed by a committee of the British Association for the Advancement of Science in the years 1863 and 1864, and known as the British Association unit, may be taken as 0.9866 of the ohm.

9. That the standard of electrical current should be denominated the ampère, and should have the value one-tenth (0.1) in terms of the centimetre, gramme, and second.

10. That an unvarying current which, when passed through a solution of nitrate of silver in water, in accordance with the specification attached to this report, deposits silver at the rate of 0.001118 of a gramme per second, may be taken as a current of one ampère.

11. That an alternating current of one ampère shall mean a current such that the square root of the time average of the square of its strength at each instant in ampères is unity.

12. That instruments constructed on the principle of the balance, in which by the proper disposition of the conductors, forces of attraction and repulsion are produced, which depend upon the amount of current passing, and are balanced by known weights should be adopted as the Board of Trade standards for the measurement of current whether unvarying or alternating.

13. That the standard of electrical pressure should be denominated the volt, being the pressure which, if steadily applied to a conductor whose resistance is one ohm, will produce a current of one ampère.

14. That the electrical pressure at a temperature of 15 degrees C. between the poles or electrodes of the voltaic cell known as Clark's cell, prepared in accordance with the specification attached to this report, may be taken as not differing from a pressure of 1,434 volts by more than one part in one thousand.

15. That an alternating pressure of one volt shall mean a pressure such that the square root of the time-average of the square of its value at each instant in volts is unity.

16. That instruments constructed on the principle of Lord Kelvin's quadrant electrometer used idiostatically, and for high pressures, instruments on the principal of the balance, electrostatic forces being balanced against a known weight, should be adopted as Board of Trade standards for the measurement of pressure, whether unvarying or alternating.

(Signed)

COURTENAY BOYLE.	G. CAREY FOSTER.
KELVIN.	R. T. GLAZEBROOK.
P. CARDEW,	J. HOPKINSON.
W. H. PREECE.	W. E. AYRTON.
RAYLEIGH.	T. W. P. BLOMEFIELD.

Nov. 29, 1892. (Secretary.)

SPECIFICATION REFERRED TO IN RESOLUTION 10.

In the following specification the term silver voltameter means the arrangement of apparatus by means of which an electric current is passed through a solution of nitrate of silver in water. The silver voltameter measures the total electrical quantity which has passed during the time of the experiment, and by noting this time the time average of the current, or if the current has been kept constant, the current itself can be deduced.

In employing the silver voltameter to measure currents of about one ampere the following arrangements should be adopted. The kathode on which the silver is to be deposited should take the form of a platinum bowl not less than 10 cm. in diameter, and from 4 to 5 cm. in depth. The anode should be a plate of pure silver some 30 sq. cm. in area, and 2 or 3 mm. in thickness. This is supported horizontally in the liquid near the top of the solution by a platinum wire passed through holes in the plate at opposite corners. To prevent the disintegrated silver which is formed on the anode from falling on to the kathode, the anode should be wrapped around with pure filter paper, secured at the back with sealing wax. The liquid should consist of a neutral solution of pure silver nitrate, containing about 15 parts by weight of the nitrate to 85 parts of water.

The resistance of the voltameter changes somewhat as the current passes. To prevent these changes having too great an effect on the current, some resistance besides that of the voltameter should be inserted in the circuit. The total metallic resistance of the circuit should not be less than 10 ohms.

METHOD OF MAKING A MEASUREMENT.

The platinum bowl is washed with nitric acid and distilled water, dried by heat, and then left to cool in a desiccator. When thoroughly dry it is weighed carefully. It is nearly filled with the solution, and connected to the rest of the circuit by being placed on a clean copper support to which a binding screw is attached. This copper support must be insulated. The anode is then immersed in the solution so as to be well covered by it and supported in that position; the connections to the rest of the circuit are made. Contact is made at the key, noting the time of contact. The current is allowed to pass for not less than half an hour, and the time at which contact is broken is observed. Care must be taken that the clock used is keeping correct time during this interval. The solution is now removed from the bowl, and the deposit is washed with distilled water, and left to soak for at least six hours. It is then rinsed successively with distilled water and absolute alcohol, and dried in a hot air bath at a temperature of about 160°C. After cooling in a desiccator, it is weighed again. The gain in weight gives the silver deposited.

To find the current in amperes, this weight, expressed in grammes, must be divided by the number of seconds during which the current has been passed, and by 0.00118. The result will be the time average of the current, if during the interval the current has varied.

In determining by this method the constant of an instrument the current should be kept as nearly constant as possible, and the readings of the instrument taken at frequent observed intervals of time. These observations give a curve from which the reading corresponding to the mean current (time average of the current) can be found. The current, as calculated by the voltameter, corresponds to this reading.

SPECIF CATION REFERRED TO IN RESOLUTION 14.

Definition of the Cell.

The cell consists of zinc and mercury in a saturated solution of zinc sulphate and mercurous sulphate in water, prepared with mercurous sulphate in excess, and is conveniently contained in a cylindrical glass vessel.

Preparation of the Materials.

1. The Mercury.—To secure purity it should be first treated with acid in the usual manner, and subsequently distilled in vacuo.

2. The Zinc.—Take a portion of a rod of pure redistilled zinc, solder to one end a piece of copper wire, clean the whole with glass paper, carefully removing any loose pieces of the zinc. Just before making up the cell dip the zinc into dilute sulphuric acid, wash with distilled water, and dry with a clean cloth or filter paper.

3. The Zinc Sulphate Solution.—Prepare a saturated solution in a flask (pure re-crystallized") zinc sulphate by mixing in a flask distilled water with nearly twice its weight of crystals of pure zinc sulphate, and adding zinc oxide in the proportion of about 2 per cent. by weight of the zinc sulphate crystals to neutralize any free acid.* The crystals should be dissolved with the aid of gentle heat, but the temperature to which the solution is raised should not exceed 30°C. Mercurous sulphate treated as described in 4 should be added in the proportion of about 12 per cent. by weight of the zinc sulphate crystals, and the solution filtered, while still warm, into a stock bottle. Crystals should form as it cools.

4. The Mercurous Sulphate.—Take mercurous sulphate, purchased as pure, and wash it thoroughly with cold distilled water by agitation in a bottle; drain off the water, and repeat the process at least twice.‡ After the last washing drain off as much of the water as possible. Mix the washed mercurous sulphate with the zinc sulphate solution, adding sufficient crystals of zinc sulphate from the stock bottle to insure saturation, and a small quantity of pure mercury. Shake these up well together to form a paste of the consistence of cream. Heat the paste, but not above a temperature of 30°C. Keep the paste for an hour at this temperature, agitating it from time to time; then allow it to cool; continue to shake it occasionally while it is cooling. Crystals of zinc sulphate should then be distinctly visible, and should be distributed throughout the mass; if this is not the case, add more crystals from the stock bottle, and repeat the whole process. This method insures the formation of a saturated solution of zinc and mercurous sulphates in water. Contact is made with the mercury by means of a platinum wire about No. 22 gauge. This is protected from contact with the other materials of the cell by being sealed into a glass tube. The ends of the wire project from the ends of the tube; one end forms the terminal, the other end and a portion of the glass tube dip into the mercury.

To Set Up the Cell

The cell may conveniently be set up in a small test tube of about 2 cm. diameter, and 6 or 7 cm. deep. Place the mercury in the bottom of this tube, filling it to a depth of, say, 1.5 cm. Cut a cork about 0.5 cm. thick to fit the tube; at one side of the cork bore a hole through which the zinc rod can pass tightly; at the other side bore another hole for the glass tube which covers the platinum wire; at the edge of the cork cut a nick through which the air can pass when the cork is pushed into the tube. Wash the cork thoroughly with warm water, and leave it to soak in water for some hours before use. Pass the zinc rod about 1 cm. through the cork.

Clean the glass tube and platinum wire carefully, then heat the exposed end of the platinum red hot, and insert it in the mercury in the test tube, taking care that the whole of the exposed platinum is covered. Shake up the paste and introduce it without contact with the upper part of the walls of the test tube, filling the tube above the mercury to a depth of rather more than 2 cm. Then insert the cork and zinc rod, passing the glass tube through the hole prepared for it. Push the cork gently down until its lower surface is nearly in contact with the liquid. The air will thus be nearly all expelled, and the cell should be left in this condition for at least 24 hours before sealing, which should be done as follows:

Melt some marine glue until it is fluid enough to pour by its own weight, and pour it into the test tube above the cork, using sufficient to cover completely the zinc and soldering. The glass tube should project above the top of the marine glue.

The cell thus set up may be mounted in any desirable manner. It is convenient to arrange the mounting so that the cell may be immersed in a water bath up to the level of, say, the upper surface of the cork. Its temperature can then be determined more accurately than is possible when the cell is in air. In using the cell sudden variations of temperature should, as far as possible, be avoided.

Notes.

The Zinc Sulphate Solution.—The object to be attained is the preparation of a neutral solution of pure zinc sulphate saturated with $ZnSO_4$, 7 H_2O. At temperatures above 30°C. the zinc sulphate may crystallize out in another form; to avoid this 30°C. should be the upper limit of temperature. At this temperature water will dissolve about 1.9 times its weight of the crystals. If any of the crystals put in remain undissolved they will be removed by the filtration.

The amount of zinc oxide required depends on the acidity of the solution, but 2 per cent. will, in all cases which will arise in practice with reasonably good zinc sulphate, be ample. Another rule would be to add the zinc oxide gradually until the solution became slightly milky. The solution when put into the cell should not contain any free zinc oxide; if it does then, when mixed with the mercurous sulphate, zinc sulphate and mercurous oxide are formed; the latter may be deposited on the zinc and affect the electromotive force of the cell. The difficulty is avoided by adding, as described, about 12 per cent. of mercurous sulphate before filtration; this is more than sufficient to combine with the whole of the zinc oxide originally put in, if it all remains free; the mercurous oxide formed together with any undissolved mercurous sulphate is removed by the filtration.

The Mercurous Sulphate.—The treatment of the mercurous sulphate has for its object the removal of any mercuric sulphate which is often present as an impurity. Mercuric sulphate decomposes in the presence of water into an acid and a basic sulphate. The latter is a yellow substance—turpeth mineral—practically insoluble in water; its presence at any rate in moderate quantities has no effect on the cell. If, however, it is formed the acid sulphate is formed also. This is soluble in water, and the acid produced affects the electromotive force. The object of the washings is to dissolve and remove this acid sulphate, and for this purpose the three washings described in the specification will in nearly all cases suffice. If, however, a great deal of the turpeth mineral is formed it shows that there is a great deal of the acid sulphate present, and it will then be wiser to obtain a fresh sample of mercurous sulphate rather than to try by repeated washings to get rid of all the acid. The free mercury helps in the process of removing the acid, for the acid mercuric sulphate attacks it, forming mercurous sulphate and acid which is washed away.

The cell may be sealed in a more permanent manner by coating the marine glue, when it is set, with a solution of sodium silicate and leaving it to harden.

* See THE ELECTRICAL WORLD, Sept. 26, 1891.

†This extract consists of four resolutions and some addenda, which were published in *The Electrician* (London), vol. xxix., Aug. 6, 1892, p. 462.

‡ See notes at the end of this article.

An Ideal Central Power Station.—II.*

BY C. J. FIELD, E. J. COOK AND F. BOURNE.

Boilers.—This sectional water tube type of boiler has been more extensively used, probably, than any other where high pressures were required, and it has in general cases met the requirements of this practice. We found, however, in some particular parts of our work, especially in power work, where the load is subjected to violent fluctuations, that this sectional type of boiler lacks steam room capacity to stand the violent fluctuations of load. Without experimenting too much, it seemed, on looking over the field, that the boiler which had been so largely developed for marine practice, as the internally fired marine type of boiler, offers the best solution of the difficulty, with modifications and changes. Such a type of boiler is described in the following specifications:

BOILER SPECIFICATIONS.

Type.—Internally fired, direct fire tube marine boiler.

Pressure.—To be tight under 160 pounds working pressure and tested to 210 pounds hydrostatic.

Capacity.—To evaporate three pounds of water from 100 degrees and 70 pounds pressure (M. E. unit) per square foot of heating surface. In other words, 10 square feet of heating surface per horse power.

Economy.—To evaporate nine pounds of water from 120 degrees F. at temperature corresponding to 160 pounds steam pressure per pound of good Scranton anthracite pea coal when developing its rated capacity.

Quality of Steam.—The steam furnished by boiler when developing its rated capacity shall not exceed 2½ per cent. of moisture as determined by calorimeter.

Furnaces.—To be of either the corrugated or Adamson type, having a common combustion chamber.

Riveting.—Longitudinal seams of shell to be butt jointed and double butt strapped and triple riveted each side of butt. Circumferential seams to be double riveted. Flanges and heads to be single riveted. All holes to be drilled when sheets are in position for riveting.

Staying.—Boiler to be stayed in the most approved manner to withstand 100 pounds working pressure. Strains on welded braces must not exceed 6,000 pounds per square section. Solid stays must not have strains to exceed 9,000 pounds per square inch of section. All straps, braces and rivets to be of the best double refined iron.

Manholes and Handholes.—Each boiler to have at least four manholes to facilitate cleaning, as well as a sufficient number of handholes for the same purpose.

Plates.—All plates to be of the best marine steel of 60,000 pounds tensile strength.

Fronts.—Each boiler to be supplied with neatly designed furnace fronts and cast iron bridge walls.

Fixtures.—Each boiler to be supplied with necessary supporting lugs or saddles, one set of grate bars for each furnace, all necessary dampers, flue and cleaning doors and frames.

Fittings.—Each boiler to be supplied with a pop safety valve, steam gauge, water column, gauge cocks and stand pipe, asbestos blow-off cock, stop and swinging check valves and necessary flanges for steam pipe connections riveted to boilers.

General Conditions.—Boiler to be set to return the gases to the front underneath the bottom of the boiler. All material and workmanship to be first class in every respect and certificate of test and nspectio n furnished.

PIPING SPECIFICATIONS.

The flanges are recessed, male and female, for gasket, to prevent the "blowing out" of the same. The effort is considerable if the gasket is thick. The flange is screwed on the pipe and then calked n on the inside. The small recess in the back of the flange around the body of the pipe is to be filled and calked with babbitt or steam metal in case of leakage of screw joint when circumstances will not permit, for the time being, to break the joint and recalk the pipe itself. The threads on the pipe should be cut by the same person, chasing the threads on flanges so as to secure the same taper on both; a very essential condition to a tight job. The screw joint should be made up in plumbago, to be removed, if necessary, at a future time without breaking. The flange should be designed to be equally strong through bolt holes as any other part of the flange. This is easily done by means of bosses about bolts. It is hardly possible to get flanges too heavy for the work. The initial strain due to screwing them on the pipe is so large that the factor of safety that remains is not usually sufficient to withstand the higher steam pressure, together with the increased expansive strains due to the increased temperature at the higher pressure.

Gaskets.—Copper corrugated gaskets are all right in the case of mains, where the joints are made up with the ends of the pipe free to move; in fact, they could be omitted altogether in such a case, and the joint made iron to iron; but there is the practical consideration that in case of repairs (and that time is sure to come) the line will be always distorted from its original position; *i. e.*, it will have initial strains, due to some part of it having steam on to run a portion of the plant; and when the joint is broken for repairs, it is possible to bring the flanges back in the same relative position they previously occupied, and for this reason alone, I prefer the use of a wire insertion rubber gasket of very thin material, say not over 1-16 of an inch thick. This will make up, or rather allow, for this slight inequality of the flange facings, and permit a tight job to be made where a copper gasket or iron to iron would leak.

Expansion Joints.—The average slip joint will not answer at all for high pressure, for when the packing is adjusted sufficiently tight to prevent leaking it will also be sufficiently tight to keep the joint from moving to take up the expansion, and if loose enough for this it will be found to leak.

Probably the best way to take up the expansion in a high pressure system is by means of long pipe bends of easy radius, and with all the brances so located, and of sufficient length to take any expansion of the mains by means of their flexibility on account of their small size. Judicious arrangement of this sort can be made without the use of any expansion joints whatever. Under restricted and peculiar conditions copper bends with iron bands can be used with good effect, if commercial considerations are not prohibitive.

Pipe.—Wrought iron or steel lap welded pipe will answer most conditions successfully, even in case of long bends or elbows made from this material. The tests should be rigid to avoid defective seams caused by bending. Extra heavy pipe will not be found necessary.

Fittings.—These should be of the best charcoal iron, true to pattern and of workmanlike finish. The flanges should be ribbed in preference to being thickened up, on account of shrinkage strains in metal.

Valves.—There should be gate valves, operated by an outside screw. The spindle should be of steel, and tinned. The body should be extra heavy and ribbed to prevent any springing, which would cause the valve to leak around the seats when closed. The valve body should be stiffer than any other part of the system in order to have all the valves tight. The seats of valves should be bronze or brass, and able to withstand the high temeratures of the high steam pressures, as well as very non corrodible.

All valves over seven inches diameter of port should have a bypass valve (a smaller valve about 1½ to 2½ inches in diameter) of exactly similar types, so that the pressures can be equalized on both sides of the large valve before it is opened by means of the smaller one. This relieves the excessive strain on the spindles and seats, and should always be used on high pressure work.

Support.—A high pressure steam pipe should always be supported, when possible, from underneath, by means of some solid mass, so that its weight would rest directly upon this support. This method, when it is possible to follow it, will be found to eliminate that vibration so often noticed, and the result of which is leaky joints, caused by the racking and straining of the whole piping system.

Generators.—Generators for electric railway service should be constructed with a view to efficient handling of variable loads and excessive overloads for short periods. They should be mounted on a brick foundation set on a bed of concrete. The top of masonry should be provided with a wooden foundation base; this wooden base to be built up of two layers of timber, with tar paper or some good insulating material between the layers, the first layer bolted by means of foundation bolts direct to the masonry, the upper layer being bolted to the lower layer, thus assuring good insulation between the iron foundation frame of generator and the ground. This precaution is taken with a view of protecting the generator from lightning coming in over the line.

Generator Frame in Belted Type.—The foundation frame of the generator should be bolted directly to the wooden cap of the foundation and provided with grooves and sliding arrangement for tightening the belt. The practice of over-compounding a machine so as to obtain an increased electromotive force with increased load—in some cases 10%—is not a good method where a number of generators are in operation.

A better method in large installations is to provide an auxiliary bus which can be connected at any time with any one or more generators, this auxiliary bus to be run at a higher electromotive force, say 575 to 600 volts, and run in connection with it the heavily loaded feeders, or those feeders which are of much greater length than the average of the system. This method reduces the quantity of wire required to run a system and maintain a fairly uniform pressure over the different lines. Arrangements should be made on the switchboard so that any feeder or any generator may be connected to or disconnected from this auxiliary bus, or to or from the main bus, the main bus to be run with an electromotive force of 500 volts, the same as in ordinary practice. In other words this divides the switchboard up into two distinct arrangements, electrically separated from each other. This has been tried in practice and has proved very satisfactory.

The armature of the machine should be run in self-oiling bearings, made with adjustable globe seats, so as to insure perfect alignment, and provided in the larger sized machine with outboard bearing at the pulley end of the shaft.

Carbon brushes have proved very satisfactory, and are almost universally used at the present time. The machine should be so constructed that the brushes should not need readjustment for any change of load from zero to 25% overload.

The generators should be capable of developing their normal output for a continuous run, and also capable of developing at least 25% above their normal capacity for short periods without undue heating of any part of the armature, bearings or fields.

The three wires from the machine, namely, the positive, negative and equalizing wires, are all carried direct to a 3-pole switch; the equalizing wire is connected to an equalizing bus, and the ground wire to ground bus. The line wire of the machine from the switch is connected to an ampere meter and also to an automatic cut-out, and from there to the main bus. If an auxiliary bus is used the wire, instead of being connected directly to bus, is connected from the automatic cut-out to a transfer switch, which enables the wire to be connected through to auxiliary of main bus. The main bus is in connection with a main ampere meter, the other terminal of the ampere meter being connected directly to the feeeder bus. The feed wires are brought in the station to the switchboard and attached to a single pole switch; from this to an ampere meter, then through an automatic cut-out; then to the feeder bus, each feeder being provided with a lightning arrester. The line wire from the machine above described should be taken from the series field side of the machine, as this series winding affords a very good protection from lightning coming in over the line, acting as a very efficient "kicker coil." The ground bus should be connected direct to the rails near the station, and also to a suitable ground bus within the station.

To insure an equalization of load between the various generators, all the dynamo mains of the same potential should be of equal resistance, provided the machines are of equal capacity, and have a resistance inversely proportionate to their capacity, if of unequal capacity. The usual method followed is to calculate the size of the mains required for the generator farthest from the switchboard; then make the generator mains of the other machines of the same length as this, using the same size wire. In other words, all the positive mains will be of equal resistance, all the negative mains will be of equal resistance, and all the equalizing mains will be equal. It is not necessary to make the equalizing mains of any larger carrying capacity than the others.

Great care should be exercised in making joints between the different instruments and mains to insure good conductivity, as a poor joint will throw the most careful calculations out. The usual method adopted now for making joints is to use a mechanical clamp having the contact surfaces perfectly clean, and of ample surface contact. In operating the switchboard care should be taken that all instruments required to be used to throw a generator in or out of line should be so arranged that the operator is not required to leave his position at the switch, controlling the generator at the board. To obtain this result the voltmeter may be arranged on a carriage which can travel along the length of the board and make automatic connection to any generator as it reaches a position exactly opposite the instruments connected with that generator. By suitable arrangement the voltmeter can be switched, when in position, with the feeder bus, and also with the generator which it is to test, so that, without moving the instruments, pressure of the line or pressure of the machine may be taken and the machine brought up to the same electromotive force as that of the line before being connected into service. The automatic regulators on the generator should be adjusted to cut out the generator when the overload of the machine is more than it will safely carry, even for short periods. The automatic regulators on the feeders should be adjusted for an excessive overload on that feeder, as in many cases of railway service the feeder is subjected to excessive overloads for very short periods, and it is a source of great inconvenience to have an automatic regulator continually cutting out the line on overloads of very short duration.

The latest types of switchboards are built of fireproof material perfectly incombustible. The framework may be built up of iron pipe or of angle iron, and if located near the wall it should be set up at least twenty to twenty-four inches from the wall, and iron braces from top of frame anchoring into the wall. The general design of this frame is dependent entirely upon the number of instruments and their location on the board, as care must be taken that, with the present method of back connections on the instruments, the cross bars of the frame do not interfere in any way with the bare wire coming through back connections, and should be a safe distance to prevent any danger from grounds. To this iron frame should be securely bolted large slabs of marbleized slate or white marble. Asbestos cloth or other cushioning device should be interposed between the slate and the contact points of the iron frame, so that the slate slabs may be securely fastened without risk of breakage. If slate is used, it should be carefully tested after all holes are drilled, to insure perfect installation. All instruments to be used on the board should then be connected directly to the slate slabs, and not set on independent sub-bases unless absolutely necessary. As before mentioned, all connections on the instruments should be made from the back of the board, and no wiring exposed from the front. At the same time, all connections and wire should be so located as to be easily accessible for repairs or inspection. Where wires are passed through the floor below the switchboard, the holes should be fitted with a floor insulator of hard rubber made watertight so that the floor beneath the switchboard may be kept perfectly clean, and if any water accumulate it shall not be able to follow the wire down through the floor.

In addition to the foregoing arrangement of the switchboard, the following plan may be used: Instead of running three wires directly from each generator to a three-hole switch on the switchboard, take the equalizing wire from each machine and run to a common point, using a short bus, or any method of connecting which may be deemed most practical; so that all equalizing wires shall be of equal resistance to this point. Then take the ground main from the generator and run directly to the ground bus. The line main from the generator is then taken directly to the switchboard and connected to a single pole switch. From this switch connections will be made similar to the board already described. This arrangement provides a switchboard in which all wires are of the same polarity, and it insures a very safe method of operating. The only objection to this is that it is impossible to cut out the machine entirely from the switchboard, and it is therefore advisable in using this method to have each generator equipped with a double pole switch attached directly to the generator controlling both lines.

Regarding the grounding of positive or negative wire, a great variety of opinion is expressed by engineers as to the better method; some advising the grounding of positive, and others the neutral wire, the result which it is desired to obtain being a condition which will produce the least electrolytic action at contact points in the ground return, such as bond wires, supplementary, etc.

*For the first section of this article see THE ELECTRICAL WORLD, Dec. 31, 1892, p. 427.

Chicago Going Into the Electric Lighting Business.

On Monday evening, Dec. 19, Alderman Tripp introduced into the Chicago City Council the following significant resolutions:

Whereas, The city of Chicago is at present the owner of and operates several electric light plants for the purpose of lighting the streets of the city of Chicago; and

Whereas, Power enough already exists to supply the city of Chicago and its inhabitants with electricity for light, heat and power; and

Whereas, The said city of Chicago has the right to run its wires without expense through existing conduits already laid in many of the streets of the city of Chicago, and it is desirous that the city should be in a position to furnish to the inhabitants thereof electricity to be used for light, heat and power, and the same could be done by a slight amendment of the present city charter; therefore, be it

Resolved, That a committee of seven of this Council be appointed by the chairman thereof to proceed to Springfield as soon as the legislature convenes, and to urge upon the legislature and the Governor of the State of Illinois the necessity of so amending the charter relating to cities and towns that such cities and towns may be in a position to issue bonds and to construct the necessary appliances for the purposes of this resolution.

These resolutions were finally passed, but the chairman, Alderman Sexton, has not yet named the legislative committee. Of course these resolutions met with favor around the city buildings, as any resolutions would that increased the powers and the patronage of the members of council.

Assistant Corporation Counsel Chetlain expressed himself as greatly in favor of the step, and said that legally it was all right. "There is no reason," he said, "why Chicago should not derive a revenue from its gas and electric plants and furnish the public with light, heat and power. The legislature will fix the rates and place the necessary restrictions, of course, but the whole matter can be easily done."

Alderman Tripp estimates the expense of accomplishing the whole thing at half a million dollars. It is proposed to raise this amount by the issuance of bonds secured by the electric light plants just as the city's water certificates and bonds are secured by the waterworks system.

The argument has been used in favor of the resolution that the city's competition with existing companies would force them to reduce the price of their service, and that the city could furnish electric light cheaper than gas and still realize a handsome profit.

Mayor Washburn has expressed himself unequivocally in favor of the move, and Governor-elect Altgeld is believed to be friendly to it.

We are very much afraid that our friends are building upon a very uncertain foundation. Take the resolutions, for instance. In the first place there is not power enough in the three municipal lighting stations to supply any large number of private consumers in addition to their present load. In the second place, the city owns no incandescent generators or circuits and but limited accommodation could be afforded from arc light circuits, either in the way of light, heat or power, and in the third place it is exceedingly doubtful if the city could demand from existing companies the free use of their conduits by means of which to compete with these same companies. They can demand the free use of sufficient conduits for purely municipal purposes, but we take it they have no right to demand them for any other purposes.

If the city builds its own conduits, and it would have to build many if it is going into the lighting business on an extended scale, where can it put them? Many of the streets are already full from the curb to the street railway tracks.

As to raising the necessary funds by issuing bonds secured by the electric light stations, it is very problematical whether it could be done. The reference to the method adopted by the water department is not a good one, for the latter has an income and the lighting stations have none. Such security would not, therefore, be considered first class. Nor can the city issue additional bonds as long as the assessment is maintained at the present figures and the 5 per cent. constitutional limit stands. The legislature undoubtedly has the power to increase the limit if it chooses, but any such step would be considered so dangerous that it is not likely to be taken.

But the most taking argument with the public is the promise held out of a revenue to be derived by the city from this electric light venture. Where is there an instance in which municipal control has ever resulted in profit to others than the politicians? And what has there been in Chicago's experience to warrant the assumption that she will do better than other cities? Her competition will not be feared by existing companies, and prices will certainly not be lowered by reason of it if past experience is any criterion by which to judge. The profits in electric lighting are too small to admit of municipal manipulation. They cannot exist except under the most careful business management, and this we know is not the fruit of the spoils system.

But the whole move can doubtless be explained in one short sentence. Next spring there will be another municipal election, and it becomes necessary now to do something meritorious, or popular, to pave the way for reelection.

Experimental Researches on Alternate Current Transformers.—II.*

BY DR. J. A. FLEMING.

6. The results of some of these observations are given in the fourth column of Table I., in which the determinations of the power absorption of various transformers at no load obtained by different methods are collected. In this table the eighth column gives the "apparent watts" absorbed at no load, or the numerical product of magnetizing current and primary volts; and the ninth gives a number which it is convenient to call the *power factor* of the transformer at no load—it is the ratio of the *true* to the *apparent* watts. If the currents and pressures were simple sine functions, then the power factor in that case would be the cosine of the angle of lag of primary current behind the primary terminal potential difference.

TABLE I.

POWER ABSORBED BY VARIOUS TRANSFORMERS WITH OPEN SECONDARY CIRCUITS AT A FREQUENCY OF 83 COMPLETE PERIODS.

TRANSFORMER.	1 Maximum output in watts from secondary.	2 Magnetizing current in ampères.	3 Primary volts.	4 Power in watts absorbed at no load. By voltmeter method.	5 By ammeter method.	6 By dynamometer wattmeter, W.	7 By Swinburne wattmeter.	8 Apparent power, W'.	9 Power factor, $\frac{W}{W'}$.
Ferranti—									
(1885 pattern)	1,875	.18	2,416	288	....	....	....	432	.66
(1885 ")	3,750	.337	2,400	540	580	549	511	808	.68
(1885 ")	7,500	.25	2,435	444	....	....	....	609	.74
(1885 ")	11,250	.34	2,447	578	....	....	....	816	.70
(1885 ")	15,000	.57	2,389	1,019	....	....	....	1,368	.75
(1885 pattern rewound	3,750	.11	2,400	.....	...	233	220	264	.88
(1892 pattern)	7,500	.075	2,400	.....	....	138	....	580	.77
(1892 ")	11,250	.076	2,400	.....	....	148	116	182	.81
(1892 ")	15,000	.112	2,400	.....	....	228	195	269	.85
(1892 pattern rewound	11,250	.103	2,400	.....	....	228	....	247	.92
Swinburne "hedgehog"	3,000	.74	2,400	112	111	112	74	1,775	.063
Westinghouse	6,500	.05	2,400	93.5	97	95	95	120	.79
Mordey-Brusht	6,000	.076	2,400	126	...	140	106	182	.77
"	750	.0317	2,392	61.5	....	....	....	76	.81
Thomson-Houston	4,500	.083	2,400	.....	....	108	83	199	.54
Kapp	4,000	.145	2,400	.....		152	112	348	.61

†The power determination by the three voltmeter method—viz., 126 watts—was made on one transformer, No. 1,952. The power determination by the dynamometer—viz., 140 watts—is the mean of four values obtained on another transformer, No. 1,868, one value of which is also 126 watts.

In criticising these results, it must be borne in mind that several of the transformers were intended to be used at a frequency of 100, and not at 83, and that therefore comparisons between the resulting numbers are not to be instituted without regard to this circumstance. As an example of a series of voltmeter tests, the details of the observations on a series of transformers at no secondary load are given in full in Table II. of the original paper.

TABLE II. (ABSTRACTED).

TESTS OF POWER ABSORBED ON OPEN SECONDARY CIRCUIT BY VARIOUS TRANSFORMERS, TAKEN BY THE THREE VOLTMETER METHOD.

(1). Westinghouse transformer, 6,500-watt. R = 9,678 ohms; frequency = 86.7 complete periods; magnetizing current = 0.049 ampère; power factor, 0.79; apparent watts taken up at no load, 118. Mean of five readings = 93.5 watts.

(2.) Mordey transformer, 6,000-watt. R = 12,620; frequency = 82.7 complete periods; magnetizing current, 0.0724 ampère; power factor, 0.72; apparent watts taken up at no load, 173.7. Mean of seven readings = 126 watts.

7. The application of the three voltmeter method to closed magnetic circuit transformers, or transformers with large power factors at no load, showed that it was possible with care to obtain very fairly good power determinations agreeing well with one another; although the number of instruments to be read rendered it exceedingly difficult, unless the pressure was absolutely steady, to get the benefit of the full possible individual accuracy of each instrument. The moment, however, that we turned attention to transformers with small power factor, such, for instance, as the Swinburne "hedgehog," the difficulty of obtaining very consistent results was considerably increased. The reason for this is fully explained in a paper by Prof. Ayrton and Dr. Sumpner, "On the Measurement of the Power Given by any Electric Current to any Circuit." (See THE ELECTRICAL WORLD, May 2, 1891, p. 329 and May 23, p. 375.)

Assuming currents and potentials to vary harmonically, they show that if the same percentage error, e, is made in reading each voltmeter, the percentage error in the calculated power will be

$$\sqrt{\frac{2 + 4\,(1 + \cos\ \Phi)^2}{\cos^2 \varphi}}$$

times e, where $\cos \varphi$ may be approximately taken to be the same quantity as that which we have above called the *power factor*. Hence, if $e = 1$ and $\cos \varphi = 0.75$, the multiplier is found to be 5; but if $e = 1$ and $\cos \varphi = 0.06$, then the multiplier is 40. In other words, a uniform error of 1 per cent. in the voltmeter readings makes only 5 per cent. error in the power when operating on a closed circuit transformer; but a 1 per cent. voltmeter error means a 40 per cent. error in the power when testing a "hedgehog." Hence, unless the very greatest constancy in the alternating pressure can be obtained, the three voltmeter method will not give good results when applied to an open magnetic circuit transformer. In order to show the extent of variation of the power determinations from the mean value, when applying the three voltmeter method to a "hedgehog" transformer on open secondary circuit, the individual values obtained on different occasions are grouped together in Tables III. and IV. of the original paper.

In the first set of observations R was kept constant, and the values of V_1 varied slightly; in the second and third set V_1 was kept absolutely constant, and R was adjusted to make this the case. In the third set the conditions for greatest accuracy were best obtained, V_1 being kept constant, and V_2 made as nearly as possible equal to V_1 by varying R as required. The mean value of the power absorbed by the open circuit "hedgehog" in these experiments was respectively 155, 101 and 85 watts at no load. The mean of the means is 114 watts. The mean of all the 30 determinations made with the three voltmeter method is 112 watts. This is, therefore, the mean result for the power in watts absorbed by the 3,000-watt "hedgehog" transformer on open secondary circuit when worked at a frequency between 83 and 88. The greatest value of the watts is 171 and the least 64; and the greatest deviation from the mean is 49 watts—or, roughly, 50 per cent. The transformer was marked by the maker to be worked at 100 periods per second. We used it at 83 to 88. It appears, therefore, that, owing to the low power factor of this transformer, it is a bad subject for the three voltmeter method, and that even with the greatest precautions considerable deviations from the mean may occur in making a series of power measurements in its case. Nevertheless, it will be shown later on that there is reason to believe that the mean value so obtained of the power absorbed at no load—viz., 112 watts—is not far wrong.

8. As regards the three voltmeter method itself, considered as a practical method of measuring alternating current power, the following conclusions were impressed upon us: (1) It is only applicable in cases when a very steady alternating pressure can be obtained of the requisite amount, and it is, therefore, unsuitable in general for working as a workshop method, or off commercial alternating circuits. (2) Owing to the number of instruments to read, it is difficult to carry it out as a practically useful method without the assistance of several observers. (3) It is especially difficult, if not impossible, to get good results with it when applying it to test transformers of open magnetic circuit type, and having, therefore, a small power factor. (4) Unless all the conditions for maximum accuracy can be secured, owing to the nature of the formula for the calculation of the power, the results will not be very trustworthy.

9. In applying the method to measure the power taken up in the primary circuit of a transformer when the secondary circuit is loaded up, the non-inductive resistance R must be capable of passing the full primary current required, and yet be capable of being so adjusted that at each stage of the load the fall of volts, V_2, down this resistance, is approximately equal to the pressure, V_1, on the terminals of the primary of the transformer being tested. It is essential that this last condition shall hold good, or else we do not obtain the same probability of accuracy in the calculated value of the power given to the primary circuit at all loads. It was found, therefore, that the most convenient arrangement to employ for the non-inductive resistance was one or more parallel series of incandescence lamps. We employ one series of 24 50-c. p. 100-volt lamps, and two series of 24 16-c. p. 100-volts lamps, the three series being arranged in parallel when required, and any required number out of the 24 lamps in each series taken. In order to measure the resistance at any instant of this bank of lamps, the second set of six non inductive resistance coils was arranged in series with the lamps, and the drop in volts down this known resistance measured with the Kelvin electrostatic voltmeter. This gives us the current flowing through the lamps, and the Swinburne voltmeter gave us the P. D. over lamps and resistance. Hence, knowing the terminal P. D. and the current, we have the value of non-inductive resistance r_1 at any instant given by the inspection of two voltmeters. In making the full test at all loads of a transformer by this method, the power given out from the transformer was taken up on a bank of incandescent lamps, and the current and terminal volts measured by a Kelvin balance and Kelvin multicellular electrostatic voltmeter. The results of a double series of observations on a Ferranti 5-h. p. 1885 (old form) transformer and those on a Swinburne 3,000-watt "hedgehog" are tabulated in Table V., VI., VII. and VIII.

[Tables V. and VI. were for the Ferranti transformer and VII. and VIII. for the "hedgehog." In all of them the primary volts were kept at 2,400. The secondary were 100. The final temperature of the Ferranti was 212° F., the resistance of the coils being 12.50 and 0.0252 ohms at that temperature. The final temperature of the "hedgehog" was 145° F., the resistances being 24.00 and 0.051 ohms at that temperature. The frequencies were 81.7, 84.8, 83.7 and 82.3, respectively, in the four tables. Table V. shows that the primary ampères rose from 0.336 to 1.516, the secondary ampères rose from 0 to 30.07, the secondary volts fell from 100.4 to 99.2. The total power dissipated in the transformer rose from 516 to 571 watts. Table VI. shows that the primary ampères rose from 0.329 to 1.9, secondary ampères rose from 0 to 39.19, the secondary volts fell from 100.9 to 98.5. The total power dissipated in the transformer rose from 509 to 720. Table VII. shows that the primary current rose from 0.738 to 1.578, the secondary

* Abstract of a paper read before the Institution of Electrical Engineers (London). For the first section see THE ELECTRICAL WORLD of Dec. 24, 1892.

ampères rose from 0 to 30.., and the secondary volts fell from 102 to 99. The total power dissipated in the transformer varied between 81 and 209. Table VIII. shows that the primary ampères rose from 0.76 to 1.566, the secondary ampères rose from 0 to 29.93, and the secondary volts fell from 102.1 to to 98.8. The total power taken up in the transformer varied between 0 and 237.]

(To be continued.)

NEW BOOKS.

ANNUAL OF THE OFFICE OF NAVAL INTELLIGENCE: General Information Series, No. 11. Published by the Navy Department, Washington, 1892.

The present volume of the Annual is the eleventh in the series of General Information from Abroad. The chapter on electricity which is included in each of these annuals is given this year in the form of notes on the progress made since the publication of the last volume. These notes cover about 30 pages of the Annual, and were compiled by Ensign John J. Blandin. A large number of very handsome plates accompany the descriptive matter, which treats of generating sets, ventilating sets, switchboards, searchlights, signaling, etc.

DYNAMOMETERS AND THE MEASUREMENT OF POWER. By John J. Flather. 215 pp., 77 ills. New York: John Wiley & Sons. 1892. Price, $2.00.

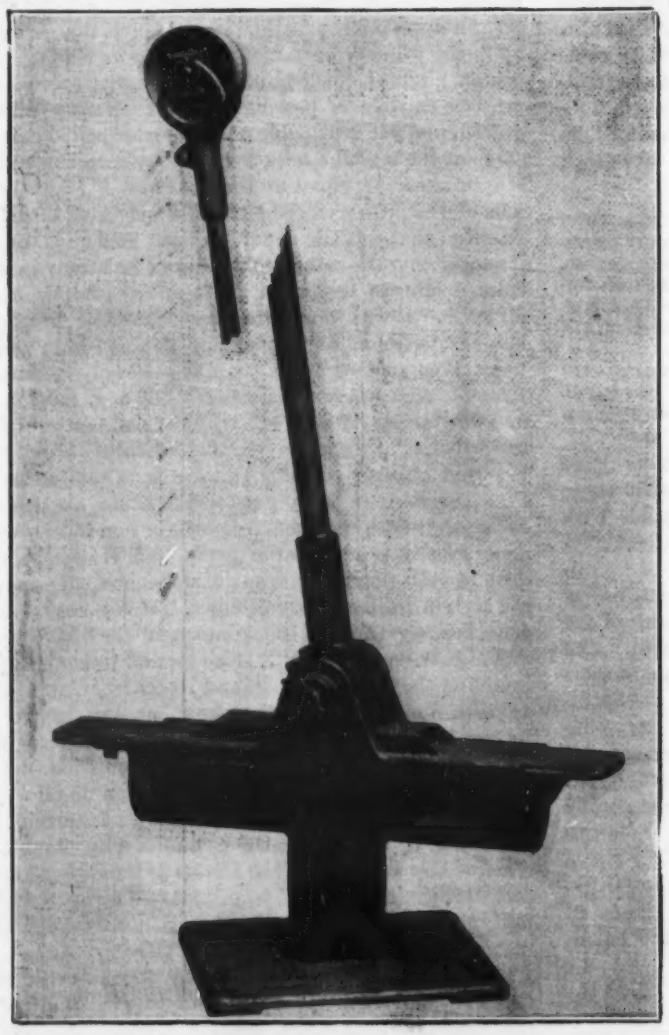
The measurement of power is a subject that is of as much importance to the electrical engineer as to the mechanical, and this little work will be found of great service to a large class of men engaged in the operation of electrical apparatus who have found it necessary to make tests either of individual machines or central stations which involve the use of dynamometers. The aim of the author has been to present in convenient form for the use of technical students and engineers a description of the construction and principles of action of the various types of dynamometer. The work is an outgrowth of a series of articles published by the author in the columns of the *American Machinist*. The subject is covered in six chapters as follows: Determination of driving power; friction brakes; absorption dynamometers; transmission dynamometers: power required to drive lathes, and the measuring of water power.

The Harris Patent Anti-Friction Trolley Base.

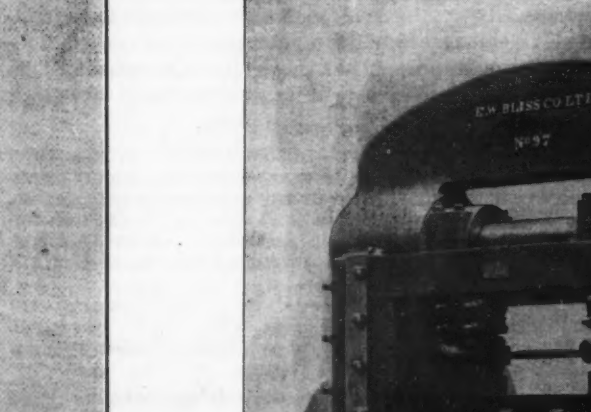
Although not of such primary importance as a sound roadbed, or a highly efficient motor, yet the trolley attachment is of considerable importance in making up the best equipped electric car. Of the many and various kinds of trolley bases in use, the one illustrated herewith is well deserving of attention. It is light, easy of adjustment, and exceedingly strong. The stand is made from one malleable iron casting, having an upright arm, 4⅞ inches long. The body is also made from one malleable iron casting, and has a sleeve fitting arm on stand, and made to revolve freely, by means of an anti-friction roller bearing.

Encased in the body are two highly tempered spiral springs. Covering the body, and thus protecting the springs, is a cast steel plate 25½ inches long, and 4 inches wide, fitted to a body by a grooved joint. A rack in the centre of this plate has teeth which are made to mesh with the teeth in the steel pinion. The steel pinion is cast on the socket for holding the trolley pole.

These parts, with a few minor fittings, comprise the whole base. The Brooklyn Street Railway Company, of Cleveland, O., says that during the twelve months since it first put these into use the repairs on them having been nominal as compared to other trolley bases which the company has used. All parts are made interchangeable. This appliance is manufactured by the Steel Motor Company, Cleveland, O.



THE HARRIS PATENT ANTI-FRICTION TROLLEY BASE.



PFLUGER'S WIRE TIGHTENER.

Pfluger's Wire Tightener.

In lining up a building for an arc light circuit, the wire should be taut and straight. To accomplish this insulators must be screwed to the ceiling at different intervals between ceiling boards, to keep the wire from sagging, which often not only disfigure the ceiling, but are in many instances the cause of grounds in the circuit.

To obtain a perfectly straight and taut line wire the lineman often has considerable trouble, and has to use different tools, such as come-alongs, tackles, pulleys, etc. For this purpose the ceiling board shown in the accompanying illustration has been designed. A glance will show its working. The ceiling boards are placed in their proper positions where lamps are required and pieces of wire, reaching from one ceiling board to the following one, are cut off, care being taken not to cut them off too short. Both ends of the wire are then fastened in the revolving binding posts of the two different boards and these binding posts are wound up with a wrench until the wire is straight and taut. The dogs engaging the rachet will prevent the unwinding of the wire. The lamps are hung in the usual way to the ceiling board. Each ceiling board is provided with a switch, to take the lamps out of the circuit when it becomes necessary. The advantages claimed for this ceiling board are that it secures a perfectly straight and taut circuit without any insulators, that it saves a great deal of time in the construction, and, therefore, considerable expense; that all kinds of wire, no matter how crooked, can be used, and that the wire can be removed instantly for the purpose of cleaning the ceiling without any damage to the wire and board.

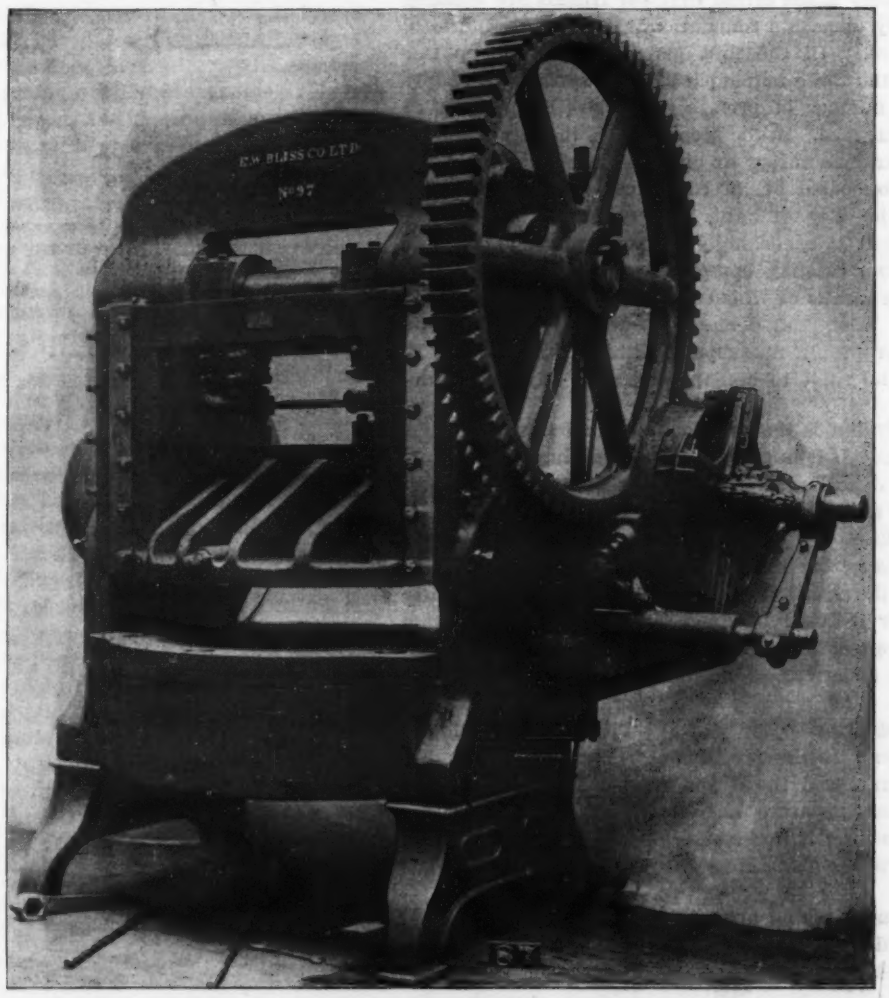
The ceiling board is patented and manufactured by Chas. A. Pfluger, of the Standard Electric Company, 313-317 S. Canal street, Chicago, Ill.

Large Power Press for Cutting out Armature Discs.

The cut illustrates a press for cutting out large armature discs as recently built by E. W. Bliss & Company, Limited, No. 141 Plymouth street, Brooklyn, for the General Electric Company. The construction of this press embodies a number of special features which have not heretofore been used in connection with presses of this class. In order to give a firm support and accurate guidance to the large and delicate dies, the ordinary centre gib has been abandoned and the ways of the slide are spread apart so as to be as wide as the frame itself. This has also made it possible to lengthen the ways considerably without increasing the height of the frame. The cut shows very well the additional solidity and accuracy due to this mode of construction.

Another special feature is the application of a new automatic friction clutch which obviates entirely many of the difficulties experienced with the regular automatic clutches on heavy back geared presses. Its application and construction will be understood from the cut. A pressure on the foot treadle shown releases the weight which actuates a powerful friction clutch on the back shaft, thus starting the press almost instantaneously, and obviating entirely the heavy metallic blow, which in the ordinary clutches tends to destroy the parts and frequently causes expensive delays and repairs. After the shaft has made one complete revolution a cam releases the friction clutch, bringing into action at the same time a brake, and thus stopping the slide at the highest point of the stroke.

The large gear wheel, instead of revolving continually, is, with these new clutches, keyed on to the shaft and is at a standstill until the clutch is thrown into action. This constitutes an additional advantage, in the saving of considerable wear on the shaft and wheel hub. There is nothing about these clutches which is liable to get out of order, and for whatever wear may be occasioned by continuous use, easy means of compensation are provided. This press will cut armature discs 30 inches in diameter and larger. It has a distance between the housings of 54 inches, and is generally made with a 30-inch round opening in bed, which, however, can be varied to suit special requirements. It is geared 1 to 10 and has a flywheel weighing 1,800 pounds on the back shaft. The weight is about 30,000 pounds. E. W. Bliss & Company, Limited, also make a variety of smaller presses of this class, many of which are now in use in nearly all the large electrical works.



LARGE POWER PRESS FOR CUTTING OUT ARMATURE DISCS.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

[Inquiries from our patrons for information relative to stocks and bonds of the various electric light and power companies are solicited, and will be answered in this column.]

NEW YORK, Dec. 31, 1892.

NEW YORK GENERAL FINANCIAL STOCK MARKET.

The market of the past week met the expectations of the bull element. Its tendency was upward and material advances were scored in nearly the entire list. This movement was more in the nature of a reaction than that of a general improvement in financial conditions. It can be said without fear of contradiction that the monetary situation, while a little easier, has experienced no change which will warrant the conclusion that a permanent improvement is in sight. To be sure the exports of gold were reduced from $4,400,000 last week to $880,000 this week. This was due, not to any better feeling in the European mind in regards to our finances, but to an accumulation of exchange bills during the Christmas holidays. Under the surface there is a feeling that there will be considerable gold exported after the first of the year, and the banks and various other institutions are making their preparations to be in a fortified position if such movement takes place. Thus we know of certain very important measures which are pending in the industrial stocks which will not be consummated until the financial atmosphere is clearer. In the stock market the fluctuation was quite pronounced, especially in the industrials, and closed generally firm at higher figures than those of the opening. There may be a slight reaction to-morrow owing to the indisposition of brokers to carry stocks over the holidays. This, however, will not be pronounced unless there is some tangible news of gold engagements for next Tuesday shipments. Should no gold be taken next week, the release of large sums mentioned just preceding in the payment of interest and dividend will stimulate the market and cause an advance. Reports from various commercial centres are that the holiday trade is up to expectations.

NEW YORK ELECTRICAL STOCK MARKET.

The entire list of these specialties was strong and, as prophesied by us, led the advance in the general market. It has become an established fact that the electrical stocks are regarded as prime investment securities, and are less liable to be influenced by conditions which cause the violent fluctuations in the general list. This fact has been demonstrated by their strength during the past two weeks. Special features will be treated elsewhere in this column. We again call attention to the persistent inquiry for some of the high priced telegraph stock, which up to the present time has not met with any recorded sales. The bid price on Mexican Telegraph has advanced from 175 to 180, and the asking price from 190 to 200. There are daily inquiries for Northwestern Telegraph at 102. Commercial Cable shows a little weakness, which is undoubtedly in the nature of a reaction. No sales were recorded; 173 was bid and 177½ asked. American Telegraph & Cable was firm and quiet at quotations given in the attached table.

North American.—On Dec. 27 fire destroyed the Kinnenick Avenue car barns and stores belonging to the Milwaukee Street Railway Co., in Milwaukee. These are far distant from either of the power stations, and are only one of the six car sheds owned by the company in various parts of the city. The only injury is the temporary loss of a few motors, which are already being supplied. The loss, amounting to about $160,000, is fully covered by insurance. The Milwaukee Street Railway Company is owned in part by the North American Company. The course of the stock was downward, and was indicative of "that tired feeling" on the part of the "dear public," who have begun to think that there are other investments liable to make quicker returns. In consequence, holders are letting go. The lowest point reached was 9¼. At the close there was a slight rally to 10⅛. We are reliably informed that insiders are not selling, but on the contrary regard the intrinsic value of their stock as double the current quotation. The news of the fire noted above did not affect the stock.

Western Union.—This stock scored a net advance of 3 points for the week on limited transactions. The close was 95½ and very firm. The fact that the quotation continues to range around these high figures indicated that public confidence in the property is being restored, and leads to the assumption that the Vanderbilt interests have been quietly increasing their holdings. To be sure, the present price is based to a degree on a sentiment. The stock pays 5 per cent. and sells at 95½. Distillers pays 6 per cent. and sells at 66. Cordage preferred pays 7 per cent. and sells at 112. Thus it will be seen that Western Union occupies a plane midway between a security that has little or no public faith back of it, and one which is regarded as a gilt-edged investment. To the degree in which this faith is strengthened or weakened will the stock approach one or the other of these standards.

General Electric.—The opening was at 110⅛ and the closing at 111¼ after reaching 112¼ in the mid-week. The stock was quiet and firm. The history of this stock since it was listed on the Exchange has been that it acts and reacts over a range of about 5 points, 115 being the maximum and 110 being the minimum. We see no reason why history should not repeat itself. The collateral trust fives were quite active, reaching 100¾ on Tuesday. This, according to insiders, is fully justified. They claim that the bonds are selling too low as compared with other securities. The company is paying nearly $3,000,000 per annum in dividends on its common and preferred stocks, whereas yearly interest on the bonds (which is payable in gold) requires only $500,000. It is claimed that the bonds ought to sell fully as high as the stock taking into calculation the 30-year call at 120. At the last meeting of Governors of the Stock Exchange $3,931,000 worth of 5 per cent. bonds were listed. The proceeds are to be used to increase the business.

Westinghouse.—Mr. Thomas W. Lawson, of Boston, prominently identified with electrical interests, says: Since the recent rise in Westinghouse from 25 to 40 and subsequent decline to 30, the Street has been filled with rumors of the cause; some of the guesses are of such a nature that I feel called upon to give the real facts for the benefit of many who have bought Westinghouse on my recommendation. The rise from 25 to 40 was not caused by the manipulation of a pool. At the request of some strong capitalists of New York and Boston, I made an examination of the affairs of the Westinghouse company and, as a result, purchased for them the greater part of the stock sold between 25 and 40. This was the cause of the rise. The stock purchased has gone into the hands of people who can, if they will, buy the entire capital stock and not curtail their regular business. Not 1,000 shares of the stock would probably come on the market if the price went to 45, or to 50. The drop from 40 to 30 was not caused by the inability of any pool to carry their holdings. When the price reached 40 my friends had not received by a few thousand shares the amount required, and probably could not without bidding it up to 50. I agreed to secure it between 30 and 40 and have done so. This was the cause of the decline. The bulk of the stock which sold from 40 to 30 and back to 35, has gone to join the stock bought on the first rise. This stock has not gone into hands unfriendly to the present management of the Westinghouse company. On the contrary, into the hands of those who believe most thoroughly in the methods and ability of George Westinghouse. As to the anxiety of the Westinghouse company to sell out or consolidate at 25 or 40, or their being pressed for working capital, one illustration will suffice: When the stock was selling at 37, I made an offer to the company of 45 for the entire treasury holdings, some $1,100,000, and it was refused, only on account of the price, as the stock would have gone into hands satisfactory to the present management, with perhaps as thorough knowledge of the value of Westinghouse stock as any one outside said management. I unhesitatingly advise my friends to buy Westinghouse at any price under 50. It is cheap at 50, independent of revenue derived from lamps or the lamp making business. It is cheap at 75, with its present business and the addition of the enormous revenue that must come from the new lamp, which, notwithstanding the trash that is put out about it, is in every way a complete success. It is cheap at 55 in the event of consolidation, for no sensible man would be guilty of seriously supposing that such able men as Charles Francis Adams, August Belmont, Brayton Ives, Henry B. Hyde and the other equally able men who compose the management would allow a consolidation that would not give stockholders at least 60, and it would certainly be a reflection on the brainy management of the General Electric to say that they would hesitate in taking $10,000,000 of their eight per cent. stock to purchase a property that on its present earnings would pay its own dividends and leave a surplus of $790,000 to $800,000 annually.

Mr. George Westinghouse, Jr., in a conversation with an ELECTRICAL WORLD representative, says that the new incandescent lamps of his company will be out shortly after Jan. 1. The demand for them is large, and the factories are being run to their full capacity to meet it. Mr. Westinghouse says the lamp is in no way an infringement, and that the company is prepared to defend it upon every point.

The incandescent lamp matter came up again this week, this time in a Pittsburgh United States Court. The Edison company, in applying for an injunction restraining the Westinghouse from using the incandescent lamp, alleged bad faith on the part of the latter company in regard to the injunction recently granted against the Sawyer-Man company. The Westinghouse presented affidavits disproving bad faith, and the court granted the plaintiff an injunction in which were imposed the same modification and limitations as were put in the injunction granted against the Sawyer-Man company.

The E. & M. assenting certificates secured one sale of 100 shares at $69.

Edison Electric Illuminating of New York.—This security sold at 115½, the highest point ever reached. This figure was the closing, and, judging from all indications, will go still higher if the market next week is at all active. During the recent depression, the stock made a steady advance, and transactions were mainly for investments. The first 5 per cent. bonds were in good demand, the highest quotation being 111½. This company has declared a quarterly dividend of 1¼ per cent., payable Feb. 1, 1893. Transfer books close Jan. 6 and reopen Jan. 27.

American District Telegraph.—This stock scored a net advance of 2 points for the week, its closing being 58½.

Closing Quotations.—The following were the closing quotations of electric stocks on Saturday, Dec. 31, 1892, and the range for the week in New York:

NEW YORK QUOTATIONS.

	Par.	Capital outstanding.	Lowest.	Highest.	Bid.	Ask'd.
American District Tel....	100	3,825,000	57⅛	58½	57⅛	59
American Tel. & Cable..	100	14,000,000	85½	86	85	86½
Central & So. Am. Tel....	100	6,000,000	....	....	105	115
Commercial Cables.....	100	7,716,000	....	....	173	177½
Gold Stock & Tel	100	5,000,000	.	....	100	103
Bonds.....	500	500,000	....	....	100	....
Mexican Telegraph.....		.....	....	....	180	200
Northwestern Telegraph.		.....	....	....	102	....
Postal Tel. & Cable..... ...		10,000,000	...	....	62	64
Southern & Atlantic Tel..	25	948,775	....	....	78	84
Western Union Tel.....	100	96,199,852	92½	95¼	94⅝	94⅞
Real estate bonds.....1,000		1,219,000	....	....	....	..
Debenture bonds. 1,000		1,920,000	....	..	....	..
Collateral Trust 5's....1,000		8,181,000	106	106½	....	
North American.....	100	39,767,200	9½	10¼	9¾	110
Brush Ill. Co. of N. Y.....	50	1,000,000	....	....	30	60
Edison El. Il. of N. Y.....	100	6,500,000	111¼	115½	114½	115½
" " lsts.....	...	.....	110⅞	111½	...	..
" " Deb's...		.....	....	....	....	....
Edison El. Il. of Brooklyn.	100	1,500,000	...	....	106	108
" " " " Chicago..	100	750,000	....	....	130	145
" " " " Boston... ...		.....	....	....	115	125
Edison El. Lt. Europe....1,000		2,009,000	....	....	2	6
" Bonds....		30,000	....	. ..	65	80
Edison Ore Milling Co.... ...		2,000,000	....	....	15	20
East River El. Light.....	100	1,000,000	....	....	....	65
General Electric 1,000		50,000,000	110⅛	112¼	111⅛	111⅛
Debenture 5's		10,000,000	100	100¾	....	....
Automatic Exhibition Co. ...		2,500,000	. ..	....	3	5
Mt. Morris Electric..... ...		500,000	....	....	....	65
N. E. Phonograph..... .. .		2,000,000	....	....	2	4
N. Y. Phonograph		2,000,000	....	....	2	5
N. American Phonograph ..		2,000,000	....	....	4	6
Westinghouse E. & M. Co. 1st p. 7 per cent., Cum.	50	3,717,253	..	....	....	....
E. & M. Co. Assg.....	50	5,038,116	69	69	....	....

WALL STREET NOTES.

The International Bell Telephone Company's dividend of 5 per cent. was payable on December 30th.

A prominent director of Western Union is authority for the statement that the company's earnings last week showed an increase of $38,000.

The Erie Telegraph and Telephone sub-companies made a net gain of 261 subscribers in October and November, making a total of 14,988.

The National Electrical Company has been incorporated in New Jersey, with a capital of $500,000, for the purpose of manufacturing electrical instruments.

President C. E. Arnold, of the Commercial Union Telegraph Company, says that that company has been leased to the Postal for a term of 99 years, from Jan. 1, 1893, at the rate of 6 per cent on the stock.

The Worcester Traction Company, with a capital of $5,000,000, has been incorporated in New Jersey for the purpose of buying, selling, leasing and operating street railroads by electricity, traction or other methods.

The copper market is firm and quiet at 12¼ cents for lake copper as the asking price of the company. There is very little demand, owing to the close of the year, and the taking of inventories. For this reason a few odd lots were purchased at 12¼. This does not indicate the market, however, and any pronounced demand could not be met at less than 12¼ cents.

NEW INCORPORATIONS.

New Omaha Thomson-Houston Electric Light Company (amended articles), Omaha, Neb., capital stock $1,100,000, has been formed. S. L. Wiley, H. E. Chubbuck, W. F. White and B. E. Sunny are the promoters.

Uvalde Water, Ice and Electric Company, Uvalde, Tex., capital stock $50,000, has been formed to supply electric power, etc. John H. Clark, C. W. Watt, W. W. Collier, A. A. Dial and O. Ellis, all of Uvalde, are the promoters.

Genesee Electric Light and Power Company, Genesee, Idaho, capital stock $20,000, has been formed for general illuminating and power business. W. H. Thomas, C. F. Burr, J. T. Johnson, L. K. Krum and H. Sampson are the incorporators.

The Day's Point Land and Improvement Company, of the Isle of Wight, Va., capital stock $50,000, has been formed to erect and maintain electric plants, etc. J. C. McClenethon, W. A. Morgan, H. Smart and J. S. McCone are the promoters.

The Locust Grove Investment Company, of Charlottesville, Va., capital stock $50,000, has been formed to erect electric works, etc. R. H. Rawlings, W. R. Burnley, J. B. Minor, G. B. Marshall and O. Nalle are the persons directly interested.

The Kendrick Electric Light and Power Company, of Kendrick, Idaho, capital stock $10,000, has been formed to supply electricity for illuminating and power purposes. C. A. Stine, M. Jacobs and M. T. Feron, all of Kendrick, are the promoters.

Ajax Fiber Insulation Company, Saco, Me., capital stock $1,000,000, has been formed to manufacture and deal in pulp articles of all kinds for electrical use. The organizers are C. A. Sawyer, Francis W. Jacobs, Boston, Mass., and Jas. W. Bacon, Natick, Mass.

The Palouse Electric Light and Power Company, of Palouse, Wash., capital stock $30,000, has been formed to operate electric light and power plants, telephone lines, etc. W. T. McCaskey, Henry W. Bassett, Andrew Clyde, C. T. Cress and S. X. Mitchell are interested.

The Dravosburg Light, Heat, and Power Company, of Dravosburg, Pa., capital stock $20,000, has been formed to manufacture and supply electricity for the purposes above named. Jno. M. Risher, Stephen S. Crump, and Perry A. Risher, all of Dravosburg, are the incorporators.

The Automatic Electric Signal Company, of Indianapolis, Ind., capital stock $200,000, has been formed to manufacture and sell Seaton's automatic electric railway signals, etc. Albert Kopp, Wm. S. Barkley, F. S. Galloway, B. C. Seaton and J. D. Anderson are the promoters.

The Fraley Electric Company, San Francisco, Cal., capital stock $1,000,000, has been incorporated to deal in patents, machinery and appliances for the generation of electricity, etc. The organizers are J. P. Jackson, J. B. Fargo, J. P. Comb, Solon Pattee and Ball, all of San Francisco, Cal.

The Boulton Carbon Manufacturing Company, North Tonawanda, N. Y., capital stock $60,000, has been formed to manufacture carbons, electrical machinery, etc. Wm. H. Boulton, of Buffalo, N. Y., and Augustus J. Bathaway and Geo. P. Smith, of Tonawanda, are the promoters.

The Phœnix Electric Company of New York, New York City, capital stock $300,000, has been formed to manufacture, buy and sell electrical apparatus of all kinds, etc. Daniel McKeever, Wm. Meyer, Edgar D. Thornburgh and Martin Bergman, of New York City, are those interested.

The Cincinnati Cab Call Company, Cincinnati, O., capital stock $1,000, has been formed to build, maintain, operate, etc., an automatic electric line, placing call boxes on same, etc. Albert E. Smith, Horace F. Smith, Geo. P. Carrell, H. T. Fay and Frank M. McCord, are the incorporators.

The American Gas Company of New Jersey, Camden, N. J., capital stock $500,000, has been formed to construct, lease and operate works for the manufacture and distribution of electricity and gas. G. G. Ramsdell, M. W. Stroud, of Philadelphia, and N. W. Cox, Camden, are the promoters.

The Hammond & East Chicago Electric Street Railway Company, of Hammond, Ind., capital stock $200,000, has been organized to acquire the rights, power and franchise of the Hammond Electric Railway Company and the Whiting, Hammond & East Chicago Street Railway Company, to form a consolidation of these companies and to operate them by electricity or other motive power. The promoters are W. H. Fitzgerald, Wm. Fitzgerald, C. E. Loss and Charles E. Griffin.

AFFAIRS OF THE COMPANIES.

The Edison Electric Light and Power Company, of San Francisco, Cal., has absorbed its only rival, the Electric Improvement Company. This is the second deal made by the Edison company. In November of last year the Edison General Electric Light Company absorbed the California Electric Light Company and changed its own name to the Edison Electric Light and Power Company, the price paid being $1,000,000.

The American Loan and Trust Company, of Omaha, Neb., and Boston, is offering at par and interest $100,000 of the bonds of the Houston City Railway Company, of Houston, Tex. The conservatism of the Trust company handling these bonds is one item that commends them to an investor; and the favorable showing made by the property immediately renders the bond as among the first grade, amply secured and yielding a good income. These bonds refund the bonded debt of the Houston City Railway Company and the Bayou City Railway Company, both roads having been bought by a Northern syndicate and consolidated under the name of the Houston City Railway Company. The capital stock is $1,000,000; bonds, $1,000,000. From July 1, 1891, to Aug. 1, 1892, all of the property was in course of reconstruction, the change from horse and mule power to electricity requiring almost a complete rebuilding of the road. From Aug. 1, 1892, when the electrical equipment was practically completed, the earnings were as follows:

	Gross.	Expenses.	Net.
August.....	$16,168.25	$7,913.11	$8,255.14
September.....	16,074.55	7,902.82	8,171.73
October.....	17,243.52	8,386 59	8,856.93

It is conservatively estimated that for the year ending Aug. 1, 1893, the gross income will equal $205,000; expenses, $100,000, leaving a net income of $105,000. From this deduct interest charges on bonds at 6 per cent. of $60,000, and it leaves a balance of $45,000, or 4½ per cent. on the capital stock. An important consideration in the operating expenses of the property is the absence of snow and ice, which always requires such large outlays in northern cities. The franchise runs 35 years, or 25 years beyond the life of the bonds, and is practically exclusive. The company owns 40 motor cars and 75 trail cars. The bonded debt of the company is less than $20,000 per mile, which is considerably less than that of any street railway in a city as large as Houston. The bonds are of 10 years, and payable in gold.

Special Correspondence.

NEW YORK NOTES.

Office of The Electrical World,
167-176 Times Building, New York, Jan. 3, 1893.

The Mica Insulator Company, of which Messrs. Eugene Munsell & Co., 218 Water street, are sole agents, has issued a new illustrated catalogue upon the subject of "Micanite."

Mr. F. W. Best, formerly with F. W. Best & Company, Denver, Col., has been appointed eastern representative of the new monthly magazine, *World's Fair Electrical Engineering*, with headquarters in the Tribune Building, New York City.

The Ball Electric Light Company reports that the demand for its automatic dynamos is so large that it has been obliged to greatly increase its force of employés, who are now working both night and day in order to fill the many orders on hand.

The Commercial Cable Company of New York has sent us, with the season's greeting, a handsome engraving of the building in which its offices are located, at the corner of Wall and Broad streets, in this city, showing the elaborate decorations which were displayed upon it at the time of the Columbus Quadri-Centennial celebration.

The Magnetic Club's Annual Business Meeting will be held in Room 60 of the Western Union Building, 195 Broadway, on Thursday, Jan. 12, at 5:30 P. M., for the election of officers and four members of the Governing Committee. The date of holding the next social meeting of the Club is being considered by the Governing Committee, and will soon be announced through the Secretary, Mr. George F. Fagan.

No Sale of the Underground Rapid Transit Franchise.—The Rapid Transit Commission offered for sale the franchise of the underground road at noon on Thursday, Dec. 29. There was only one bidder, W. Nowland Amory, of No. 78 W. Ninety fourth street, New York City. A number of prominent city officials and street railway men were present. Mr. Amory first bid $500, and in addition thereto one-half of one per cent. per annum on the gross receipts, which he estimated would amount to $50,000 a year. He also made a second bid of $1,000 and deposited $100 on that amount. After some consideration the Rapid Transit Commissioners passed a resolution declining to accept Mr. Amory's bids. It was a disappointment to the Commission that no other bids were received, and it is probable that some elevated system will now be developed.

Colonel Bliss Wins His War on the Wires.—Some time ago the American District Telegraph Company asked Colonel Bliss of New York City the privilege of placing a messenger call box in his residence, and a little later added a second one. Colonel Bliss soon found that the company's men were injuring his roof and suspending their wires upon a large frame which was spiked to the chimney. He tore these down and notified the company that it must not use his property for carrying its wires. Soon after the American District Telegraph Company notified Colonel Bliss that after Jan. 1, 1893, he must pay $6 per year for each box, and the Colonel prepared for active war. When the company found that Colonel Bliss was in earnest and proposed to make an open fight, it capitulated and sent an apology and a statement that no charge would be exacted from him.

The Trolley on Manhattan Island.—The New York Board of Aldermen have granted the Union Railway Company a franchise to extend its trolley system to the south of the Harlem River and Mayor Grant has signed it. The lines will run on the following streets and avenues: Through Exterior avenue from its junction with Third avenue to its junction with Eighth avenue, from the southern terminus of Madison Avenue Bridge, through Madison avenue to 130th street, through 125th street west from its junction with Madison avenue to Eighth avenue, across the Third Avenue Bridge, through 125th street west from Third to Fourth avenue, through Fourth avenue from 125th street to 130th, through 130th street from Ninth avenue to Madison avenue, from the eastern terminus of the Washington Bridge to and through Boscobel avenue to Jerome avenue and along Broadway from Kingsbridge road to the city limits on the north.

Insurance Rates and the Trolley.—The New York Tariff Association of Insurance Companies, at a special meeting held this week, appointed a committee to confer with Mayor Boody, of Brooklyn, regarding the increase in fire insurance rates in that city, owing to the alleged inefficiency of the fire department. The committee consists of J. H. Washburn, vice-president of the Home Insurance Company; M. S. Briggs, president of the Williamsburgh City Insurance Company; Geo. A. Coit, Royal Insurance Company; E. R. Kennedy, president New York Board of Fire Underwriters, and H. E. Bowers, Guardian Assurance Company. President Lockwood and Vice-President Silvey, of the Tariff Association, are ex-officio members. The committee was not instructed in any way, and will take its own time and means of conferring with Mayor Boody. Before the meeting adjourned the contemplated introduction of the trolley system in the upper part of the city by the Union Railroad Company came up. A resolution was passed directing the Committee on Rates to make an inquiry on the subject, with the object of ascertaining if it will be necessary to raise the rates in New York on account of the trolley wires. An advance of rates is expected.

NEW ENGLAND NOTES.

Branch Office of The Electrical World,
Room 28, Hathaway Building, 620 Atlantic Ave.,
Boston, Mass., Dec. 31, 1892.

The Redding Electric Company, Boston, has sufficient orders on hand to keep it busy day and night for two months.

Brown & Jenney, manufacturers of arc lamps of special designs, motors, etc., located at 481 Main street, Pawtucket, R. I., are meeting with success. They have installed many plants in their locality.

Mr. Geo. A. Beatey, Boston, Mass., has been appointed New England agent for the Detroit Electric Works, the John J. Woods, Jr., boilers, New York Safety Steam Power Company, Dewey Electric Heating Company, Syracuse, N. Y., The E. S. Greeley & Co.'s electrical instruments, and J. R. & D. Lake, manufacturers of shafting and pulleys. Mr. Beatey is now in a position to fit an electric plant throughout. He has recently moved into an elegant suite of offices in the Hathaway Building.

The Eastern Electric Cable Company, Boston, Mass., has declared a 3 per cent. semi-annual dividend on its preferred stock. The works of the above named company now cover over an acre of ground and are complete in all departments. The Clark wire and cables need no introduction to the electrical public, as the company has orders which will keep it busy for months. The success achieved is mainly due to the efforts and business ability of its president and treasurer, Mr. H. H. Eustis and Henry A. Clark.

The Interior Conduit in New England.—The Pettingell-Andrews Company has been appointed the New England agent for the wiring system of the Interior Conduit and Insulation Company of New York. The company announces that it is ready to give every assistance in the preparation of specifications for electric light wiring on this system, and it can at any time place an inspector at the disposal of parties desiring to have their work examined. The company also offers to send free a copy of its monthly paper explaining the system.

The Pawtucket Evening Times of Dec. 27 has a very interesting descriptive article on the progress made by Mr. N. B. Denison, the expert electrician and manager of the Pawtucket Steam and Gas Pipe Company. The success achieved by the above company is certainly noteworthy. Among their orders we might mention a 200-light plant for Daniels & Connell's building, Providence; a plant for the new opera house, Pawtucket; for the Contrexeville Manufacturing Company, Woonsocket. This latter is a 200-light plant, replacing an 80-light plant, with which the company's tenement blocks will be lighted.

PHILADELPHIA NOTES.

Branch Office of The Electrical World,
Room 31, City Trust Building, 927 Chestnut St.,
Philadelphia, Pa., Dec 31, 1892.

New Cars.—The cars used on the trolley system in Philadelphia are those of the Lamokin Car Company and the J. G. Brill Company.

D. S. Spruance, vice-president of the Helios Electric Company, of Philadelphia, has returned from the East, where he has been for several days on business of the company.

Mr. Frank Kohler, the Chicago agent of the Eddy Motor Company, spent the holidays with his people in Philadelphia. Mr. Kohler reports a continual increase of the Eddy motor business in Chicago.

The National Electrical Company has removed from 1,217 Filbert street to 1,223 and 1,225 same street, where the company will have better facilities for conducting its electrical specialties. This company makes a specialty of manufacturing the Warrell double and single-pole fuse blocks, and also the Warrell insulated joint.

Election of Officers.—At the meeting of the electrical section of the Franklin Institute, held last Tuesday evening, Dec. 27, the following officers were elected for the ensuing year: President, Elmer G. Willyoung; vice-president, Prof. E. J. Houston; second vice-president, C. W. Pike; secretary and treasurer, Prof. L. F. Rondinella; conservator, Dr. Wm. H. Wahl.

PITTSBURGH NOTES.

Pittsburgh, Dec. 31, 1892.

An electric canceling machine has recently been added to the equipment of the postoffice in Allegheny City. It stamps 30,000 letters per hour.

The Dubois Electric Light Company, of Dubois, Pa., has added a 60-kilowatt Westinghouse alternating incandescent dynamo to its plant, making its total capacity 2,250 lights.

The Verona Electric Light and Power Company, of Verona, Pa., completed the installation of its incandescent plan last week, and the lights were turned on for the first time.

The Braddock Electric Light Company has, owing to the great demand for incandescent lights, been obliged to considerably increase its capacity. The last dynamo the company has added is a 120 kilowatt Westinghouse alternating machine.

An Injunction Against the Westinghouse Company.—The hearing on the application of the Edison Electric Light Company before Judges Buffington and Acheson of the U. S. Circuit Court at Pittsburgh, Pa., for an injunction restraining the Westinghouse Electric and Manufacturing Company from manufacturing incandescent lamps, resulted in the granting of such an injunction, but one which followed the form and contained the same provisions as the decree of the Circuit Court of Appeals of New York in the Sawyer-Man case.

Mr. Morris K. Mead, the popular chief of the local bureau of electricity, delivered a lecture recently before the pupils of the Duquesne College upon the subject "Practical Electricity." He commenced the lecture by giving his audience a concise historical sketch of the Municipal Bureau of Electricity, which proved very interesting. He stated that ten years ago the department was in a very crude state, while to-day the fire alarm system, the police telephone system and the lighting system are considered to be as perfect as they can be found in any city in the country. It may be incidentally remarked that too much credit cannot be given to Mr. Mead for the successful operation of the Municipal Bureau of Electricity in Pittsburgh, since he has been in charge of it for many years, and it has been mainly due to his efforts and energy that the system is now so perfect.

WESTERN NOTES.

Branch Office of The Electrical World,
465 The Rookery, Chicago, Dec. 31, 1892.

Mr. G. M. Robinson, president and treasurer of the Charter Gas Engine Company, Sterling, Ill., paid his respects to The Electrical World at its Chicago office on Tuesday, 27th inst.

The Stirling Company has just closed a contract with the Indianapolis (Ind.) Light and Power Company for six of its water tube boilers, each of 250 h. p. capacity. This plant is now being installed and when completed will be one of the largest in the West.

The Enterprise Electric Company reports a large increase in the sales of the National India Rubber covered wire. The company is about to place on the market a new flush switch for which it has secured the exclusive agency. Its St. Louis branch is very active at present.

Mr. William Taylor, of the firm of Taylor, Goodhue & Ames, is quoted in a long interview in one of the Chicago dailies last week in which he points out the remarkable growth of the electrical business during the past year, and the important extensions that have been made in the field of applied electricity.

Mr. Fred. Bathurst, of the Bureau of Information of the General Electric Company, who has his headquarters at Schenectady, N. Y., called at the Chicago office of The Electrical World last week. Mr. Bathurst has been making a tour of observation throughout the West and was just returning to the East.

Maps of Electric Circuits Required.—The Board of Public Works of Millwaukee will have an ordinance introduced in the Council requiring every telephone, telegraph and electric light company to furnish a map of its wires in the city. A penalty of $10 to $100 fine for non-compliance will accompany the ordinance.

Mr. Carl Kammeyer, of the Jenney Electric Motor Company Indianapolis, Ind., was in Chicago last week en route to Eau Claire, Wis., to arrange for moving his family to Indianapolis, where he will hereafter reside. Mr. Kammeyer mentioned the closing of a nice order for generators and motors by Mr. Jenney, shortly before his departure.

The Enterprise Electric Company is fully settled in its new quarters at 307 Dearborn street, and the outlook for the sale of N. I. R. wire is reported as being most promising. Several carloads will be constantly kept in stock, to be distributed from this point. A very successful supply business has also been built up by Mr. McKinlock in a short time

The Electric Appliance Company reports large sales of its new Acme wire guards. It is placing large numbers of them with Eastern and Western jobbers, as well as supplying them to large users all over the country. The new Whitney instruments for alternating currents will be ready for the market very shortly, and also a line of cheap switchboard instruments.

The Electrical Workers' Union of Chicago elected officers for the ensuing year on the evening of Saturday, Dec. 24 as follows: President, G. Edison; vice-president, J. W. Johnson; financial secretary, A. G. Sauers; treasurer, Frank W. Woods. G. Edison was made a member of the Board of Control for the construction of the Labor Temple. The union has 840 members, and is one of the most aggressive, prosperous and closely organized of the newer unions of the city. Beginning Jan. 1, it will keep open headquarters for its secretaries the year round.

North Shore Electric Road.—J. E. Cochran, to whose efforts the organization of the Chicago North Shore Street Railway Company is chiefly due, has said that electric cars would run on Evanston avenue within a few months after the City Council ratifies the agreement between that company and C. T. Yerkes by which the tracks of the street car company from Graceland avenue to Diversey street may either be used jointly by the North Shore company or leased to the latter. The distance is only one mile and a half, but this break prevents at present the completion of the electric line to Evanston.

The Underwriters and Mercurial Alarms.—The Board of Underwriters of Chicago have directed that an investigation be made into the different systems of automatic fire alarm that are being offered for use in buildings in Chicago, and pending this investigation the rebates that have been given to the system known as the Mercurial for the past 20 years have been discontinued. There is no claim that the Mercurial has ever failed to send in an alarm of fire, but it is thought by some of the insurance men that the number of false alarms may be reduced, and the present action of the board has this end in view.

An Electrical Block System.—Mr. D. D. Tate, formerly electrician of the Denver & Rio Grande Railroad, is in Chicago making arrangements to exhibit at the World's Fair a model of his automatic block signaling apparatus. It consists of an electric circuit which is closed by the entrance of a train on a block, thus illuminating lamps at both ends and maintaining them until it has passed out, when the breaking of the circuit extinguishes them, indicating that the section is clear. He proposes also to place two intermediate lamps, and claims that there is no possibility of the apparatus getting out of order, and that the necessity of train dispatchers and flagmen will be obviated.

The Chicago Edison Company is rebuilding its battery of boilers at the Central station, No. 139 Adams street. As soon as the holidays are over it is expected that a change will be made that will entirely relieve the smoke difficulty about which so much complaint has been made. The company has spent a large amount of money in experimenting with different kinds of anthracite and bituminous coal, but without satisfactory results. A number of new devices have also been tried, but with the radical change that is now being made it is expected that there will be no further trouble. The officers of this company have been arrested several times during the past year, notwithstanding the fact that every effort possible has been made to remedy the trouble, and Mr. Gorton and his associates have had the sympathy of the business interests of the city in what has undoubtedly been an honest effort to correct a public nuisance. It is believed the problem will soon be solved.

Cincinnati, O., Dec. 31, 1892.

Prof. E. P. Roberts, electrician and superintendent of the Swan Lamp Company, and Mr. Ueberlacher, of the Short Electric Company, have formed a copartnership under the firm name of E. P. Roberts & Co., and will soon go into business for themselves as electrical engineers and experts in Cleveland. Both are well known and highly esteemed, and they have our best wishes for their success.

The Elliott Electric Company, of Cleveland, O., will soon have ready its new four-pole motor in different sizes. The main features of this new machine are its simplicity of construction and cheapness, with durability, and it shows every indication of success. This company is doing considerable repair and armature work in conjunction with its work on the 20 new summer and winter cars for its East Cleveland Street Railway Company.

The Steel Motor Company, of Cleveland, O., is now the successor of the Johnson Electric Company, with increased capital of $75,000. Its specialty will be the manufacture of railway and motor generator armatures complete with commutators, motor field coils and improved base for trolley pole and other electrical appliances for street railways, and it has the latest improved machinery for manufacturing steel gears, pinions, etc., and shows a promptness in filling orders that is worthy of the attention of street railway managers.

Bids for the municipal lighting at Cleveland, O., were opened this week, and the Brush Electric Lighting Company, on a moonlight schedule, bid $95. This was rejected as too high for 2,000 c. p. lamps. The company then offered another bid of $87.50. This has not been accepted yet, as the city talks of putting in its own plant for city lighting. L. N. Cole, of Washington, offered to furnish 2,000 c. p. lights all night for $85. It is said that there is a new company organizing with $1,000,000 capital to buy out the two local companies.

Sale of the Lima (O.) Street Railway.—The Lima Electric Railway, which was originally installed as the Van DePoele road, and operated as such until about four months ago, was purchased by W. W. Hazzard, W. M. Brown, A. E. Townsend and W. R. Kimball, and has been wholly rebuilt. There are now 5½ miles of 45 pound girder rail, and 7 cars manufactured by the Newcastle Car Company, of Newcastle, Pa., which are operated partly by 15-h. p. single w. p. and partly by 15-h. p double w. p. car equipments. The Lima electric railway rents its power from the Lima Electric Light and Power Company, the power company furnishing the plant and attention, and the railway company furnishing the generators. The power is sold according to Thomson-Houston wattmeter measurement.

Striking Linemen Cutting Wires in Toledo.—On Christmas Day a strike was ordered of all the linemen in the employ of the Toledo Electric Light, Western Electric Light and Power Toledo Electric Railway and Consolidated Street Railway companies of Toledo. Although the strike was not ordered until 3 A. M. the men went out the night before without having given warning of their intention. As is too often the case in such instances, the

strikers brought themselves within the pale of the law by destroying property. In this case they proceeded to cut the wires, thus leaving the city in darkness and stopping the cars. All day Sunday the various companies had gangs at work repairing the lines, but when darkness came on again the cutting was resumed and proceeded faster than repairs could be made. The dissatisfied workmen decided, at a meeting which continued nearly all night, to continue the strike until their demands for an increase of 10 per cent. of their wages was acceded to.

The Ford-Washburn Storelectro Company, of Cleveland, O., reports a very prosperous business during the past 30 days, and some of the orders it has filled are: Jamestown, N. Y., Street Railway Company, seven small motors with 500-volt circuits; the Empire Plow Company, Cleveland, dynamos to supply 36 32-c. p. incandescent and two arc lamps; Chicago, Ill., one 200-light dynamo; Domestic Sewing Machine Company, Cleveland, one motor for its factory; Duluth, Minn., Street Railway Company, 500-h. p. motor; Britton Rolling Mill Company, Cleveland, 100 incandescent dynamo to run arc and incandescent lights; Forest City Spring Works, Cleveland, one dynamo for arc and incandescent lighting and plant complete. The L. Schlother Brewing Company, Cleveland, 200-light incandescent dynamo; Anzeiger Publishing Company, Cleveland, one 20-h. p. motor; Bradley Block, Cleveland, 10 15-h. p. motors, 500 volts, with equipments.

The Cincinnati Street Railway Company now has something over 100 miles of street railway operated by the double trolley system. On the various lines of this company there are being operated 120 motor cars equipped with from 30 to 60 h. p. of motors per car, and 60 trail cars. All of the motors are Thomson-Houston except 16, which have just arrived, which are of the Westinghouse make. Current is furnished from three stations, the Pendleton station having nine 80-h. p. generators, the Brighton 13 80-h. p. generators, and the Hunt street station 16 of the same size. It is claimed that the leakage from the double trolley wires to the ground, or between positive and negative, is practically nothing, except when the motors themselves get grounded, and normally cannot be detected by grounded lamps or even by an ammeter reading to five ampères. In addition to the 100 miles and more of double trolley roads belonging to the Cincinnati Street Railway Co. there are about 12 miles belonging to the Cincinnati & South Covington Street Railway Co., whose cars run between Covington and Newport, Ky., and Cincinnati.

The Cincinnati Edison Company, which on its bid of $84.90 per lamp per annum was awarded the contract to light the city, has erected pole lines and nearly completed stringing its wires for the first district. The first portion of the city to be lighted by this company is known as the first district; 252 200-c. p. lamps will be used in this area, located at street intersections where these are not more than 400 feet apart, with an intermediate lamp where the distance exceeds this. In the public squares and markets the lamps will be closer together. The remainder of the city will be lighted as ordered by the Board of Legislation. On the roads leading to the outlying districts the lamps will be placed 600 feet apart. The apparatus to be used will be of the standard make and there will be required for immediate use five 50-light machines. The new City Hall will be equipped with four tubular boilers of 100 h. p. each, which will heat the building in addition to running the elevators and generators. There will be one Hale electric elevator operated by a special 220-volt generator. There will also be installed four other generators with a total capacity of 3,600 lights. The switchboard will be so arranged that any two of these can be thrown in series to operate the electric elevator in case of accident to the one specially installed for this purpose. The electrical machinery was furnished by the Western Electric Company, of Chicago, and the sale effected by the Post-Glover Company of this city. This latter company also obtained the contract to furnish the material for the lighting of the new library building of Indianapolis, the contract amounting to about $1,500.

Change of System and Re-equipment of the Wheeling Railway Lines and Connections.—About three months ago the Wheeling Railway Company let to the Central Construction Company, of Cincinnati, O., the contract for the entire re-equipment of their railway system. This company operates and controls all the street railways in Wheeling and Benwood, W. Va., Martin's Ferry, Ætnaville and Bridgeport, O. The track is about 20 miles in length and is being relaid with 75 and 78 pound girder-rails throughout, except about five miles, which is now laid with 52½ pound girder. The ties used are 6 by 8 inches by 8 feet and spaced 2½ feet between centres on paved streets and 2 feet between centres on unpaved streets. The only special construction at the joints consists of a bed of broken stone, 3 feet by 8 feet, by 8 inches in depth, the joints being suspended and the usual fish plates being used. A new brick power-house is in process of erection, the dimensions being 90 × 110 feet, and a battery of three Root boilers of a capacity of 300 h. p. each is being installed. Three cross compound Ball engines of a rated capacity of 268 h. p. have been purchased, and will be put in place within the next thirty days. Fifteen 18-foot closed car bodies of Brill manufacture are now being delivered, and 20 double 15-h. p. w. p. Thomson-Houston motors and 4 w. p. 100-h. p. Thomson-Houston generators will constitute the electrical equipment, which is in addition to the electrical apparatus heretofore used by the Wheeling Railway Company. The total number of cars to be operated will be about 30. The overhead line has been reconstructed, the double trolley being wholly abandoned and changed to single trolley. The franchises in this part of the country are perpetual except as to that part of the system which extends into Ohio, and the road is owned by New York, Cleveland, Cincinnati and Wheeling people.

News of the Week.

THE TELEPHONE.

Government Telegraph and Telephone Line.—Superintendent Kimball of the life-saving service has been officially informed that the United States government telegraph and telephone line between Assateague and Cape Charles, Va., a distance of 90 miles, has been completed and was formally put into operation last Tuesday. The line was constructed by the life-saving service, at an expense of $12,500, and includes 12 miles of submarine cable.

THE ELECTRIC LIGHT.

Llano, Tex., is discussing the question of electric lights.

Cottonwood Falls (Kan.) has contracted for electric lights.

Pueblo, Colo., has granted a franchise to the Mountain Electric Light Company.

Christiana, Pa., will soon have an electric light plant for lighting both streets and residences.

The Hanover (Pa.) Gas Company has determined to establish an electric light plant in connection with its works.

Phillips, Me.—C. B. Dalton, of Portland, is installing an electric light plant, the cost of which will be about $2,000.

Mineral Ridge, O., will be illuminated by electricity in the near future, the current being supplied by the Mineral Ridge and Niles Electric Street Railway Company.

The United States Electric Company, of Dubuque, Ia., has sold its plant to a local syndicate for $100,000. This is believed to mean a consolidation of all the electric companies in the city.

The Property of the Uxbridge and North Uxbridge Electric Company (Mass.) has been attached by the sheriff for $10,000 at the instance of the administratrix of the estate of James D. Bolen, who was killed by a live guy wire last July.

The United States Electric Company, of Dubuque, completed the sale its of electric light plant to a local syndicate on Dec. 24. The price is understood to have been $100,000. This is believed to mean a consolidation of all the electric companies in the city.

Pomona, Cal., is to have another electric light plant. The new company is to be started by men who are heavy stockholders in the Los Angeles Lighting Company and the San Bernardino company, and is intended to rival the San Antonio Light and Power Company.

"There is an amusing side to all this fuss about patents," said a friend of the Westinghouse company to a reporter of the Pittsburgh *Telegraph*, "for it is said it is a case of mining and countermining. The Edison company has started many tunnels with great secrecy and has dug away industriously with great expectations, only to find its wary opponent quietly sitting in a rocking chair awaiting the final opening, all ready with the antidotes necessary to the case."

Contracts for Public Electric Lighting.—The Gas Commissioners, at a meeting held in the Mayor's office last week, awarded a contract to the Thomson-Houston Electric Light Company for lighting 45 lamps at 40 cents a light each night for one year, from Jan. 1, 1893, the lamps being in Eighth street, the Bowery, Fourteenth to Forty-second street and Fourth to Sixth avenue. The contract for 17 lamps at 40 cents a lamp was awarded to the Manhattan Electric Light Company, for lamps between Forty-first and Fifty-ninth streets, in Madison avenue. The Edison Electric Illuminating Company received the contract for 57 lamps at 50 cents a lamp. These lamps will be in Fifth avenue between Washington Square and Sixtieth street.

A Large Isolated Plant.—One of the largest plants for isolated incandescent lighting in New England is now being installed at the Stevens street works of the American Screw Company, Providence, R. I. The plant will consist of four new U. S. 125-volt 300 ampère compound wound machines, supplemented by a 500-light Thomson Houston machine which has been in use at the works since 1887. Three of the dynamos are now running successfully over 1,200 lights and the wiring for others is being pushed as rapidly as possible. When completed the plant will comprise 2,500 to 3,000 16-c. p. lamps besides arc lamps for yard use. The entire installation has been made by the regular electrical department of the Screw company under the supervision of Mr. John P. Robinson, who has been the company's electrician for the past five years. No wiring contracts were made, nor any wiring done by outside parties. This company is also installing 500 lights in its Eddy street mill in South Providence, and 500 in its mill in Leeds, England (British Screw Company), and 600 in its Canadian works (Canada Screw Company), Hamilton, Ont., an aggregate of 3,500 to 4,000 lights.

THE ELECTRIC RAILWAY.

The South Orange (N. J.) Horse Railroad Company has made application in accordance with the permission granted to it by the Board of Works to use electricity to erect poles on South Orange avenue, outside the city limits.

Wants Fifty Miles of Streets.—The Brooklyn City Railroad Company has made application to the Board of Aldermen for consent to construct a double track street railroad upon about 50 miles of thoroughfare as part of and tributary to the system now operated by that company. The sum of $250,000 is said to have been offered for the privilege.

West Bay City, Mich.—The Philadelphia syndicate has purchased the street railway systems of Bay City and West Bay City. These consist of 25 miles of horse lines known as the Union Street Railway of Bay City, and 12 miles of electric railway in West Bay City, including a line to Winona Beach on Saginaw Bay. The price paid was between $350,000 and $400,000. The Bay City line will be changed to an electric system in the spring.

PERSONALS.

Mr. William Tracy, general manager of the Alton Gas and Electric Light Company, has resigned his position to accept a similar one at Leavenworth, Kan.

Mr. Charles P. Geddes has been elected secretary and treasurer of the Interior Conduit and Insulation Company, 42-44 Broad street, New York City, in place of Mr. F. A. Mason, resigned.

Mr. Geo. G. Ward, superintendent of the Commercial Cable Company, and Mrs. Ward celebrated their silver wedding on Thursday evening of last week, at their residence in Brooklyn. About 150 guests were present. Mr. Ward is one of the most popular men in the electrical business.

Master Don Carlos Francisco, of Rutland, Vt., met with a sad accident on Christmas Eve, which necessitated the amputation of one of his fingers. His father is one of the most prominent members of the National Electric Light Association, and Don is well known to the members, for he has acted as page at several of the conventions.

Mr. George Franklin Jones, whose death occurred in New York City this week, was associate editor of the *Telegraphic Age*. A large delegation from the Order of Commercial Telegraphers, of which Mr. Jones was formerly Supreme President, was present at the funeral. Mr. Jones was born in Goldsboro, N. C., in 1853, and was a great-grandson of John Hancock. He founded the stock brokerage firm of Bralich, Jones & Co., in Washington, D. C., and was later head operator in the new York Stock Exchange.

Capt. Albert Gallup, commanding the Signal and Telegraph Corps, N. G. S. N. Y., died on Saturday, Dec. 24. His death was a great loss to the National Guard of this State. Through his zeal and enthusiasm the efficiency of the Telegraph Corps was brought up to a high state, and he was complimented from General Headquarters for the work he performed at Buffalo last August. Though not an electrician he recognized the importance of having a corps of electricians and telegraphers whose services could be utilized by the military in time of emergencies. Mr. Gallup had completed before his death a manual of military telegraphy, which will shortly be published.

MISCELLANEOUS NOTES.

Mr. F. M. F. Cazin has called our attention to the fact that his name does not appear in the list of authors in the index to Vol. XX. of THE ELECTRICAL WORLD. The omission was accidental, as Mr. Cazin is credited with a long series of articles in another portion of the index.

The Matthews-Northrup Co., of Buffalo, N. Y., has issued in pamphlet form a collection of proofs of various styles of engravings for which that well-known establishment has so long been famous. Electrical companies and others who have much engraving done will find the book of much value to them. It is presumed that a copy will be sent free on application to any probable customer.

The Housatonic River in Connecticut is to be made the source of an immense water power, by the construction of a large dam between Oxford, Monroe and Newton. The special purpose for which the power will be used is the generating of electricity to be transmitted to long distances. The plan is in general modelled after the one in Frankfort, Germany, where power is transmitted 80 miles economically. Robert S. Hinman, of Oxford, is one of the incorporators who will present to the legislature an application for a charter for a company with a capital of $1,000,000. The cities of New Haven and Bridgeport are in close proximity and will prove profitable fields for the new company.

Amateur Electrical Union.—Some months ago a notice appeared in the columns of THE ELECTRICAL WORLD to the effect that young men who would like to form an electrical union could send their names to G. C. Minor, of Baltimore. A number sent their names, and the prime movers, G. C. Minor, Chesapeake & Potomac Telephone Company, Baltimore, Md.; Edwin Norton, Newton *Daily Republican*, Newton, Kan.; Edmund H. Perry, 24 Benson street, Bloomfield, N. J., and Samuel H. Houston, Pineville, La., took the necessary steps to complete the organization, which has about 30 members at present. The aim of the Union is the encouragement of a systematic study of electricity among young men. All the leading electrical journals will be kept on file, and lectures by leading electricians are contemplated. Any young man who will send his name and address to any of the above members will gladly be supplied with all necessary information.

LEGAL NOTES.

Relations of Street Railway Company to Free Passengers.—The Missouri Supreme Court lays it down that where a small boy becomes a free passenger on a street car, by consent of the driver in charge, the street car company is bound to exercise towards him the same care as towards other passengers.—(Buck v. People's S. Ry. & Elec. L. & P. Co., 18 Southwestern Rep., 1090.)

Promoters' Liability After Formation of Corporation for an Illegal Purpose.—Where the real purpose for which a corporation is formed is to use it as an instrumentality in the accomplishment of an illegal purpose, the fact of incorporation will not avail the promoters as a defense in a suit against them to recover money obtained by such methods.—(Brundred v. Rice, Supreme Court of Ohio, 32 N. E. Rep., 169.)

Citizenship of Corporations.—Corporations are called artificial persons, but it has been repeatedly held by the Supreme Court of the United States that corporations are not citizens of the several States in such sense as to bring them within the protection of that clause in the constitution of the United States which declares that "the citizens of each State shall be entitled to all the privileges and immunities of the several States."—(State v. Brown, Supreme Court of Rhode Island, 25 At. Rep., 246.)

Scope of a City Ordinance.—The Supreme Court of Iowa decides that where a city ordinance grants the right to transmit electric light and power, the further grant therein of a privilege to conduct to the electric light plant water from an artesian well, flowing at the intersection of two streets in the city, is incident to the object of supplying electricity, and does not contravene Code, § 489, which prohibits the passage by a municipal corporation of any ordinance containing more than one subject.—(Hanson v. Hunter, 53 Northwestern Rep. 84.)

State Cannot Tax National Franchises of Telegraph Companies.—In California, Rev. Stat. U. S., title 65, provides that any telegraph company, by filing its written acceptance, may construct and operate lines over any portion of the public domain, across any navigable water, and along any of the military or post roads of the United States; that the United States shall have priority in sending telegrams between the departments of government, its officers and agents, at rates to be fixed by the Postmaster-General; that after five years the United States may purchase such lines for postal and military purposes at an appraised value. The State Supreme Court rules that a telegraph company, by filing such acceptance, acquired national franchises, which no State could tax.—(City and County of San Francisco v. West. Union Tel. Co., 31 Pacific Rep., 10.)

Decision in a Telephone Syndicate Suit.—A verdict has been filed in the Supreme Court at Cambridge, Mass., in the case of Llewellyn Tibbets against what was formerly known as the Lowell Telephone Syndicate, composed of five citizens of Lowell, Mass. In 1879 the Lowell telephone system was sold to a syndicate which formed a company known as the Lowell District Telephone Company, which acquired many valuable telephone properties, not only in Lowell, but in Maine, Massachusetts, New York and a number of Western States, so that at one time it was claimed that it owned one-sixth of the entire telephone business of the United States. In 1885, when telephone stocks dropped so suddenly, Llewellyn Tibbets and two others brought suit against the above mentioned syndicate, and after a long fight in the courts a decision has finally been reached in favor of the defendants.

City Lighting Contract Not in Violation of its Charter.—The Supreme Court of Wisconsin decides that a contract by which a city agreed to pay an electric light company $2,050 per year for eight years, in quarterly installments, for the lighting of its streets and its city hall, will not be presumed to violate its charter, which prohibits the city from levying a tax for general city purposes in any one year in excess of 2 per cent. of the assessed valuation of the property in the city, and which declares that the city shall have no power to borrow money or contract any debt which cannot be paid out of the revenues of the current fiscal year; and, therefore, in an action by the electric light company against the city, a complaint which alleges the contract, and its breach by the city in refusing to pay two quarter-yearly installments, is not demurrable on the ground that the city had no power to enter into the contract.—(Merrill Railway & Lighting Company v. City of Merrill, 49 Northwestern Rep., 965.)

Right of Purchaser to Countermand Order Taken by Agent on Approval.—Where an agent takes an order from a person for the purchase of an article from those whom he represents, subject to their approval, it is a unilateral or one-sided contract, and subject to the countermand of the purchaser at any time

before approval, though the order said "no verbal understanding of agents to affect this order, all conditions under which same is given being specified herein; all orders subject to approval of" those whom the agent represented.—(Challenge Wind and Feed Mill Co. v. Kerr, Supreme Court of Michigan, 53 N. W. Rep., 555.)

Industrial and Trade Notes.

The Wilmington City Electric Company, of Wilmington, Del., has placed the contract for its new boiler house with the Berlin Iron Bridge Company, of East Berlin, Conn. The building will be made entirely of brick and iron, after the designs of the Berlin company.

The Pettingell-Andrews Company, of 192-202 Summer street, Boston, Mass., has sent us one of its handsome calendars for the year 1893. This calendar calls attention to the fact that the company is prepared to furnish electric railway and electric light supplies of all kinds.

The Brooklyn Electric Manufacturing Company, of 286-290 Graham street, Brooklyn, N. Y., has purchased the patent rights of the Baehr Electric Manufacturing Company, together with its entire plant. The Brooklyn company is now the sole manufacturer of the Baehr quick break switch. Mr. F. B. Sharp is the manager of the company.

The Berlin Iron Bridge Company, of East Berlin, Conn., has secured the contract for a new fire proof storehouse for the Pope Manufacturing Company, at Hartford, Conn. The building will be 40 feet wide by 84 feet in length, two stories high, and will be used for storing the separate parts of bicycles, as the Pope Manufacturing Company has to carry a very large stock of the different parts to supply the wants of the numerous users of the Columbia Safety.

The Enterprise Electric Company, of Chicago, Ill., has been in business but eight months, yet in that time its business has more than tripled, until the company is forced to find new quarters, which have been taken at 307 Dearborn street, where the company will occupy a store 25 × 125 feet, besides a basement of the same size. The company finds that its products meet with excellent demand. The National India Rubber Company's wire, it is said, is now going to be appreciated by contractors, and the demand for it is increasing.

The Racine Hardware Manufacturing Company is doing an excellent business in its engine department and is filling orders from all parts of the country. The company recently shipped one engine as far west as Seattle, Wash., several of large size to Texas, and one as far east as Massachusetts. It has also been awarded a contract for furnishing 25 launches to be used on the lagoons at the World's Fair. These boats are 34 feet long by 6 feet beam, are fitted with mahogany and all the latest appliances, and are to be driven by electricity.

The Detroit Electrical Works, of Detroit, Mich., has been kind enough to send us two very handsome calendars, each of which is ornamented with a beautiful half-tone engraving. Any of the company's customers having one of these calandars in view during the coming year will be reminded of the fact that a Chicago office is maintained in the Monadnock Building, a New York office at 18 Cortlandt street, and that this company is prepared to furnish electric light plants, electric railway, mining and power machinery and telegraph, telephone and general electrical supplies.

The Lunkenheimer Brass Manufacturing Company, owing to the increased demand for its brass and iron specialties and the introduction of new products, has been compelled to double its capital stock to $500,000. As soon as possible the manufacturing facilities of the company will also be increased. The company subsequent to Jan. 1, 1893, will transact its business as the Lunkenheimer Company instead of under the old name. The new officers are as follows: Edmund H. Lunkenheimer, president; C. F. Lunkenheimer, vice-president and treasurer, and D. T. Williams, secretary.

The Detroit City Council has formally passed a resolution instructing the Controller to amend the specifications for the new city lighting contract, so as to contain a clause favoring an automatic mast-arm cut-out safety device, and the Turbayne cut-out, manufactured by the Turbayne Electrical Specialty Company, of Detroit, Mich., will be placed on several hundred mast arms in this city. The device is automatic and is placed on the mast arm in such a way that when the arm is pulled down by the trimmer or "patrol" the falling of a weight attached to a lever changes two copper conductors from a horizontal to a diagonal position and short circuits the lamp, thus preventing danger from grounds, etc., etc. The Brotherhood of Electrical Workers has indorsed the cut-out unanimously in a petition to the Council.

The J. H. McEwen Manufacturing Company, of Ridgway, Pa., reports the following sales of engines: Scranton Glass Company, Scranton, Pa., one 80-h. p. simple engine; Rice & Birrell, San Francisco, Cal., two 35-h. p. simple; Moffett, Hodgkins & Clarke Co., Marshfield, Wis., two 100 h. p. simple; Bank of New York, New York, two 50-h. p. simple; Perry Electric Light Company, Perry, Ia., one 100-h. p. simple; Charlottesville National Electric Light and Gas Company, one 125-h. p. tandem compound; Norton Land and Lumber Company, Parfield, Mo., one 250-h. p. simple; Moffett, Hodgkins & Clarke, Medina, N. Y., one 100-h. p. tandem compound; Old Pittsburgh Coal Company, Hymera, Ind., one 160-h. p. simple; Hope Lumber Company, Hariton, Tex., one 60 and one 300-h. p. simple; John E. du Bois, Du Bois, Pa., one 60-h. p. simple; Du Bois Traction and Passenger Railway Company, Du Bois, Pa., one 50-h p. simple; N. Falkenau & Bro., Chicago, Ill., three 70-h. p. simple; O. L. Packard Machinery Company, Milwaukee, Wis., one 35-h. p. simple; Marx & Rawle, 163 William street, New York, one 70-h. p. simple; Jeffreys Manufacturing Company, Columbus, O., one 125 h. p., one 140-h. p. and 160 h. p.; H. P. Gregory & Co., Portland, Ore., one 35-h. p.; Edison Electric Light Co., La Grande, Ore., one 140-h. p.; Central Railroad Company, New Jersey, two 35-h. p simple.

Business Notices.

Transformers rewound and repaired. Write for prices. The Hill Manufacturing Company, Salem, Va.

Oil Filter for sale cheap; send for prices to Purity Oil Filter Manufacturing Company, 901 Water street, Pittsburgh, Pa.

Battery Cut-Out, Cheap.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

The Albany Lubricating Compound and Cup Company, 313 West street, New York City, has issued a very handsome calendar which will be sent to any engineer who will send his address and the name of the company with which he is connected.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

[In Charge of W. A. Rosenbaum, 177 Times Bldg., N. Y.]

UNITED STATES PATENTS ISSUED DEC. 27, 1892.

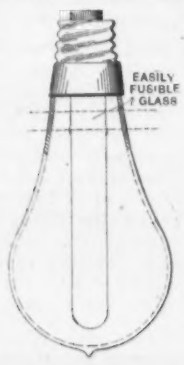
488,536. Electric Annunciator; J. H. Bates, Hoboken, N. J. Application filed June 27, 1892. In an electric annunciator, the combination with a base of an electromagnet, an indicator, and armature for the magnet, jointed to the indicator, whereby the armature is adapted to positively actuate the indicator.

488,550. Electrically Repeating Signal; S. T. Dudley, Yonkers, N. Y. Application filed March 5, 1892. In a system for repeating electrical vibrations, the combination of two or more lines inductively related at a relay station, means for producing forced electrical vibrations in the lines at such station and means for varying the force of such vibrations at the distant end of either line.

488,567. Electric Annunciator; A. B. Lyman, Cleveland, O. Application filed Oct. 26, 1891. An electric annunciator having a pair of oppositely disposed magnets, a vertical armature free to oscillate between the poles of said magnets at its lower end, a pin on said armature and a pointer pivoted on a support independent of the armature below its centre of gravity, and arranged to be actuated by said pin when the armature is oscillated.

488,579. District Signaling Box; C. E. Scribner, Chicago, Ill. Application filed July 3, 1888. The combination with the bell striker included in a shunt around an electromagnet of an answer back signaling attachment, said bell striker being provided with a notch with which the hook is engaged and a spring against which the bell striker is brought to shunt out the electromagnet and bring the hook into position to engage with the notch.

488,585. Electric Arc Lamp; E. Thomson, New Britain, Conn. Application filed July 2, 1883. The combination in a differential lamp, of a main circuit magnet whose pole piece has an



No. 488,635.—Incandescent Electric Lamp.

attraction face so that near the extremity of its armature's movement it will cease to approach the pole, and a derived circuit magnet having a curved attracting pole and armature swinging past the face thereof, the curve of the attracting magnet being made in the manner desired so that the armature shall gradually approach the pole through its whole range of movement. (See illustration.)

488,611. Thermostatic Indicator and Adjuster; E. C. Krogh, Monmouth, Ill. Application filed Sept. 2, 1892. In combination with the temperature actuating contact of a thermostat, a longitudinally moving rod forming the other contact, the spring for moving said in one direction, the cam for moving it in the other direction and the indicator.

488,615. Electric Railway Signal; F. P. Schlosser, Birmingham, Ala. Application filed June 21, 1892. The combination with three continuous conductors arranged between the rails of a railroad track, wheels carried by a train and adapted to electrically connect two of said conductors, a wheel insulated from the first mentioned wheels and adapted to make contact with the other conductor, an electric rheotome bell connected with the last mentioned wheel, each contact being adapted to always run on the same conductor when the train is running in one direction, a battery connected with an electric bell and one of the first mentioned pair of wheels, and a switch adapted to short circuit said bell and battery.

488,635. Incandescent Lamp; F. H. Prentiss, New York, N. Y. Application filed April 27, 1892. In an incandescent lamp for electric lighting, a cap composed of two parts, one of which parts is permanently fixed to the glass bulb, said two parts being easily attachable and detachable to and from each other, in combination with a glass bulb, electrical conductors and filament. (See illustration.)

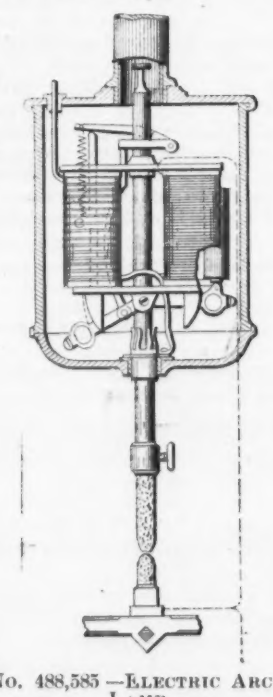
488,645. Push Button and Thermostat; E. L. Ashley and W. H. Camp, Waterbury, Conn. Application filed May 25, 1892. In a combined push button and fire alarm, the combination with two contact plates with which the two line wires are respectively connected, the thin metallic shell, the push button supported therein, an electric connection between said shell and one of said wires, a spring finger electrically connected with the other line wire and bearing against the inner wall of the shell, and a fusible coating of insulation interposed between the finger and shell,

488,654. Railroad Switch Signal; F. A. Harris, Guildhall, Vt. Application filed Aug. 26, 1892. A switch signal consisting essentially of an oscillatory trip bar with an alarm and provided with a recess in its upper side in which the end of the switch rail rests when the switch is closed.

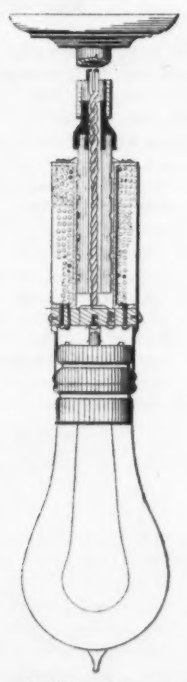
488,696. Duplex Arc Lamp; H. M. Odell, Detroit, Mich. Application filed March 28, 1892. In a double electric arc lamp the series and shunt coils and the tripping levers arranged to be actuated by said coils, and the clamps and carbon carrying rods combined with a circuit closer interposed between the direct and return wires normally closed, and arranged to be held open by the tripping lever of each lamp while the same is burning.

488,706. Trolley Catcher; William L. Browne, Worcester, Mass. Application filed July 8, 1892. The combination, with a trolley and car, of an automatic trolley catcher attached to the rear part of the car, a signaling device located at the front part of the car, and a cord or pull connecting the signal and trolley catcher, whereby the signal device is automatically actuated by the operation of the trolley catcher.

488,726. Secondary Battery; Nicholas Wladimiroff, St. Petersburg, Russia. Application filed July 7, 1892. In a secondary battery, electrodes whose opposite faces are of like chemical character or nature but of unlike polarity and provided with a spiral face groove.



No. 488,585.—Electric Arc Lamp.



No. 488,951.—Regulating Socket for Incandescent Electric Lamps.

488,735. Incandescent Electric Lamp; F. H. Prentiss, New York, N. Y. Application filed April 4, 1892. An incandescent lamp for electric lighting, having a section of the glass bulb below the metallic cap composed of a softer glass than the glass of the other parts of the lamp, in combination with the metal top, platinum wires and filament.

488,738. Closed Conduit for Electric Railways; Frank Mansfield, New York. Application filed Oct. 1, 1891. In an electric railway, the combination with a branch conductor, having a switch and an electromagnet located therein in series, the switch including a pivoted contact having its normal or operative position controlled by the magnet and thrown out of such position upon the passage of an excessive amount of current over the magnet, of a swinging contact lever included within the branch conductor and controlling the switch.

488,710. Electrical Switch; Charles E. Pattison, Boston, Mass. Application filed Aug. 8, 1892. In an electric switch, two or more fixed contacts, combined with a base plate, a disc rotatable thereon a member hinged to the disc, and adapted to co-operate with any of the fixed contacts, and means actuated by the movement of this member about its hinge to clamp the disc and base plate firmly together.

488,811. Trolley Wheel; Louis J. Hirt, Arlington, Mass. Application filed July 28, 1892. An improved trolley wheel having the walls of the groove made thin near the bottom of the groove, and reinforced by ribs whereby side wear will become visible from the outside of the wheel, while the wheel is still effective.

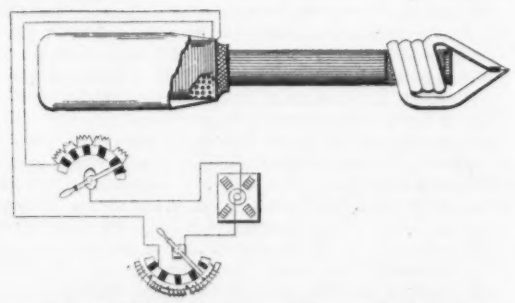
488,835. Regulating Socket for Incandescent Electric Lamps; Elias E. Ries, Baltimore, Md. Application filed July 6, 1891. A socket for incandescent electric lamps containing a closed iron ring or core wound with insulated wire arranged and adapted to be included in series with the lamp, and a switch for opening the lamp circuit and for closing it through the winding,

488,871. Electrical Soldering Iron; Charles L. Coffin, Detroit, Mich. Application filed July 23, 1891. In an electric soldering or brazing tool, in which the soldering or brazing head constitutes the secondary coil or circuit of an inductive apparatus, the combination of the secondary or soldering head, with a resistance material in circuit at or near the point of application of the head to the work. (See illustration.)

488,878. Device for Raising or Lowering Electric Lamps; William Doran, Skowhegan, Me. Application filed Dec. 4, 1890. A hanger for incandescent lamps comprising an attaching plate, shaft journaled at one end in a hanger and bearing at its opposite end upon a fixed shaft, lateral studs extending from one end of the pulley shaft, the fixed shaft keyed in the hanger, an arm carrying a stud adapted to retain the fixed shaft in its seat, the disc fixed on the fixed shaft and having lugs adapted to engage a gravitating cam, the cam having a shoulder adapted to engage the lateral lugs of the pulley shaft, parallel flexible metallic shoes connected to the attaching plate and wires leading from a dynamo, the pulley on pulley shaft provided with flanges having metallic peripheries adapted to engage the flexible metallic shoes and wires connecting the peripheries of the pulley flanges with a lamp, and all adapted to work together.

488,889. Electric Cigar-Lighter; Edward T. Gutberlet and William R. Isard, St. Louis, Mo. Application filed June 27, 1892. In an electric cigar-lighter, the combination, with a stand or upright, a contact brush or brushes, and electrical conductors communicating respectively with the stand or upright and brush or brushes, of a lamp carried by the stand or upright and insulated therefrom, the lamp being in series with a brush conductor, a wire netting enclosing the lamp and in electrical connection with the stand or upright.

488,899. Non-Sparking Electric Switch; Gwynne E. Painter, Baltimore, Md. Application filed March 11, 1892. The combination in an electric switch of a rocking lever, means for operating same, a contact bar on each end of the lever, main circuit terminals completing circuit through the bars, and two or more supplemental contacts completing circuits in advance of main terminals.



No. 488,871.—Electrical Soldering Iron.

488,928. System of Electric Distribution; Charles J. Van Depoele, Lynn, Mass. Application filed June 27, 1889. In a system of electrical distribution, a generator of electricity; an electric motor having its field magnets and armature coils in circuit with the generator, and one or more translating devices connected on one side directly to the commutator brush of the motor, and on the other side to a commutator or contact brush intermediate the motor or comutator brushes.

488,929. Electric Railway Trolley; Charles J. Van Depoele, Lynn, Mass. Application filed June 6, 1888. In an electric railway, the combination of a suspended conductor, a vehicle having upon it a pivoted contact arm, and an operating device for the arm extending down outside the vehicle.

488,930. Electric Locomotive; Charles J. Van Depoele, Lynn, Mass. Application filed April 1, 1891. An electric locomotive having a double motor upon its driving axles, the motor wheels thereof having spring webs, by which the motors are wholly supported independent of the truck frame.

488,940. Electrical Circuit for Telegraph Apparatus; Francis W. Jones, New York. Application filed Aug. 12, 1892. The combination of a main line telegraph instrument and a local circuit therefor, including a generator of electricity, a circuit breaker and an electromagnet coil.

488,946. Coupling for Light Fixtures; James A. O'Neill, Boston, Mass. Application filed July 23, 1892. In a coupling for light fixtures, a two part separable casing, a ball therein having a gas passage, and means to connect the parts of the casing, combined with insulating packing rings interposed between the ball and both parts of the casing.

488,951. Regulating Socket for Incandescent Electric Lamps; Elias E. Ries, Baltimore, Md. Application filed July 6, 1891. A regulating socket for incandescent electric lamps, provided with a self inductive conductor within the socket, in the filament circuit, and means for varying the degree of self-induction of the conductor. (See illustration.)

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1886—can be had for 25 cents. Give date and number of patent desired and address The W. J. Johnston Co., Ltd., Times Building, N. Y.